SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.
196

PHYSICAL OBSERVATIONS

IN THE

ARCTIC SEAS.

BY
ISAAC I. HAYES, M.D.,
COMMANDING EXPEDITION.

MADE ON THE WEST COAST OF NORTH GREENLAND, THE VICINITY OF SMITH STRAIT AND THE WEST SIDE OF KENNEDY CHANNEL, DURING 1860 AND 1861.

REDUCED AND DISCUSSED

AT THE EXPENSE OF THE SMITHSONIAN INSTITUTION

BY
CHARLES A. SCHOTT,
MEMB. AM. PHIL. SOC. PHILADELPHIA; ASSISTANT U. S. COAST SURVEY.

[ACCEPTED FOR PUBLICATION, FEBRUARY, 1865.]

CHART
SHOWING THE
DISCOVERIES TRACKS AND SURVEYS
OF THE
ARCTIC EXPLORING EXPEDITION
OF 1860 AND 1861
I. I. HAYES M.D.
COMMANDING

NEWLY PROJECTED FROM REVISED MATERIALS DISCUSSED FOR

THE SMITHSONIAN INSTITUTION

BY

CHARLES A. SCHOTT

Assistant U.S. Coast Survey

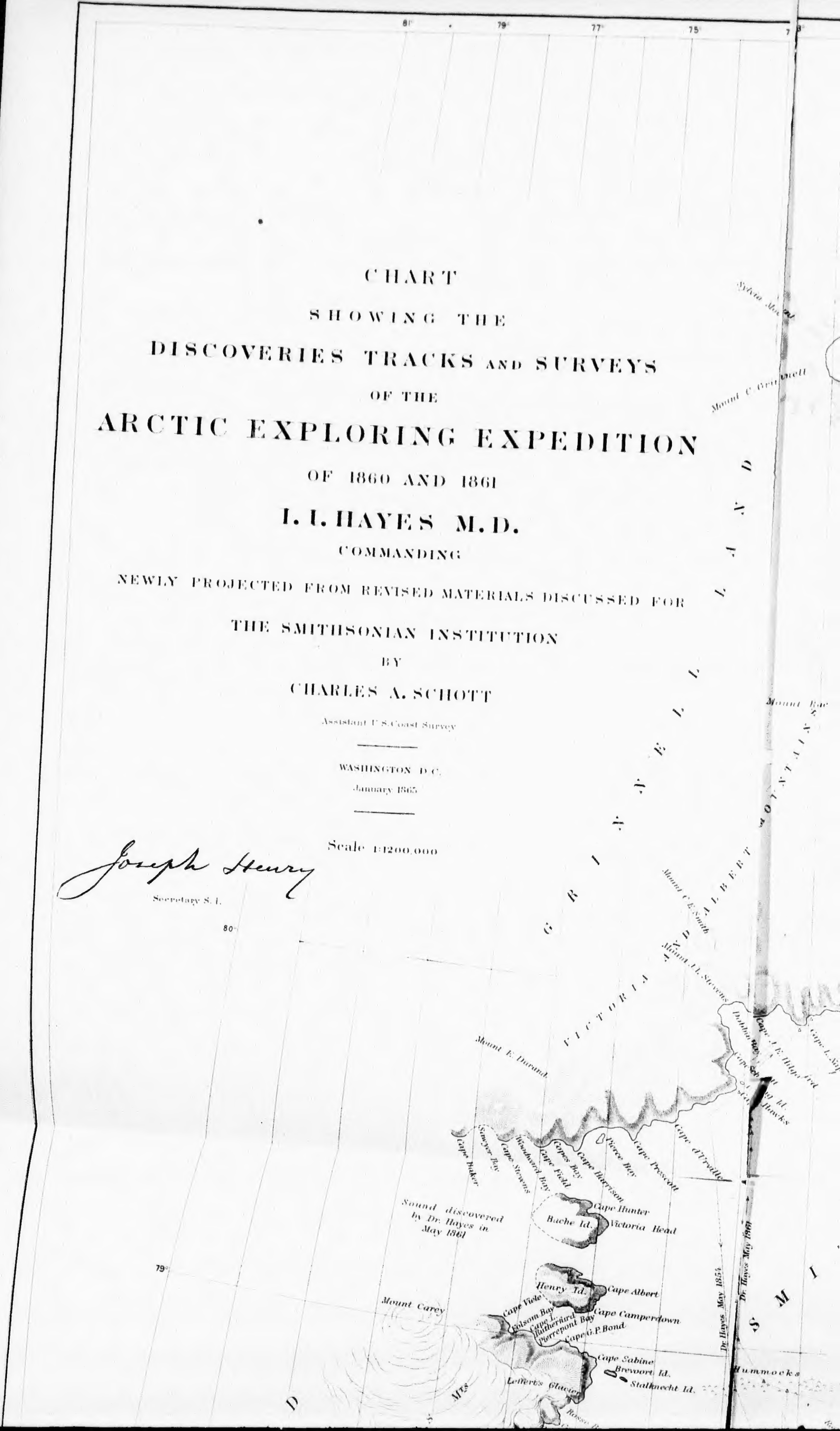
WASHINGTON D.C.

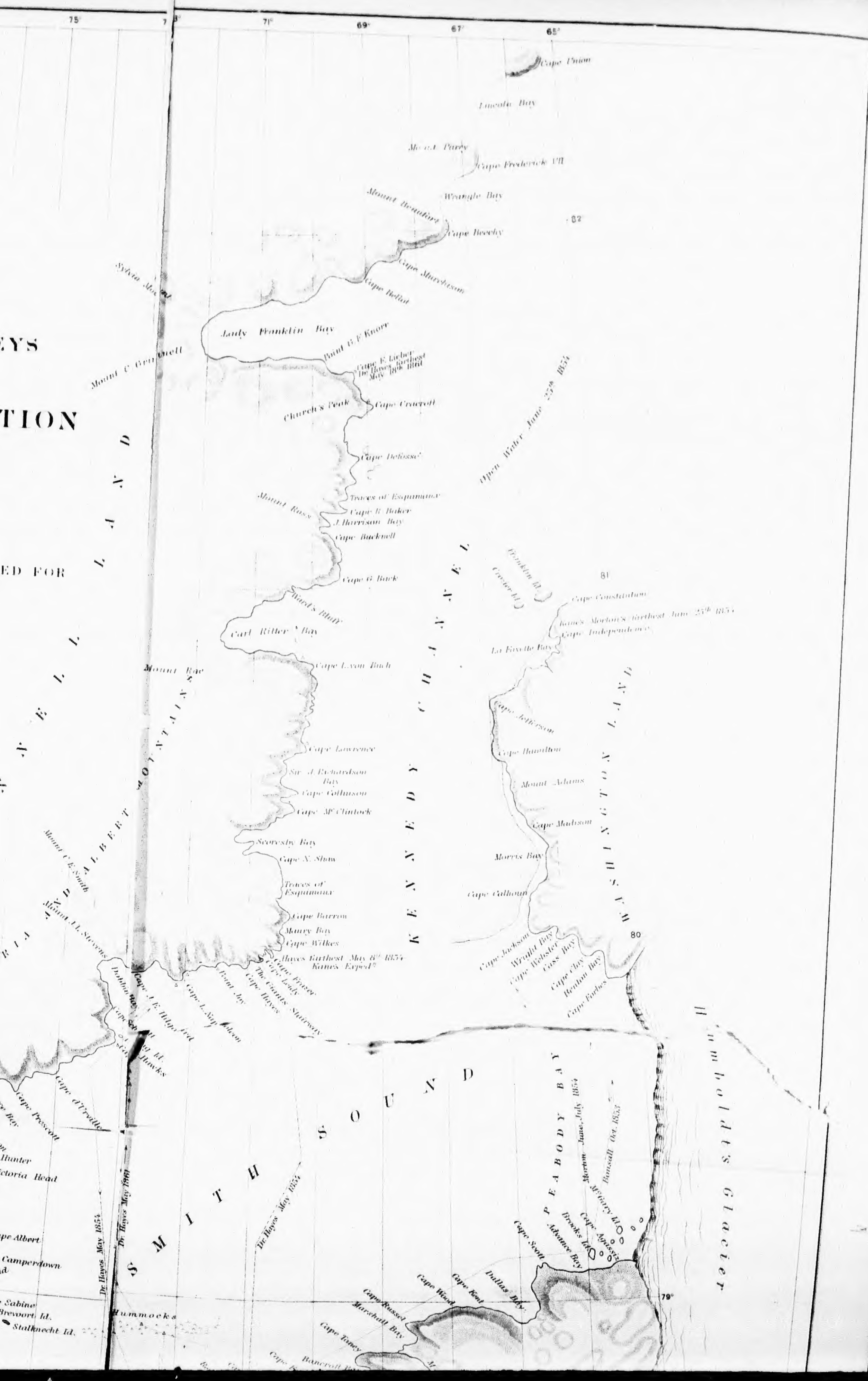
January 1865

Scale 1:1200,000

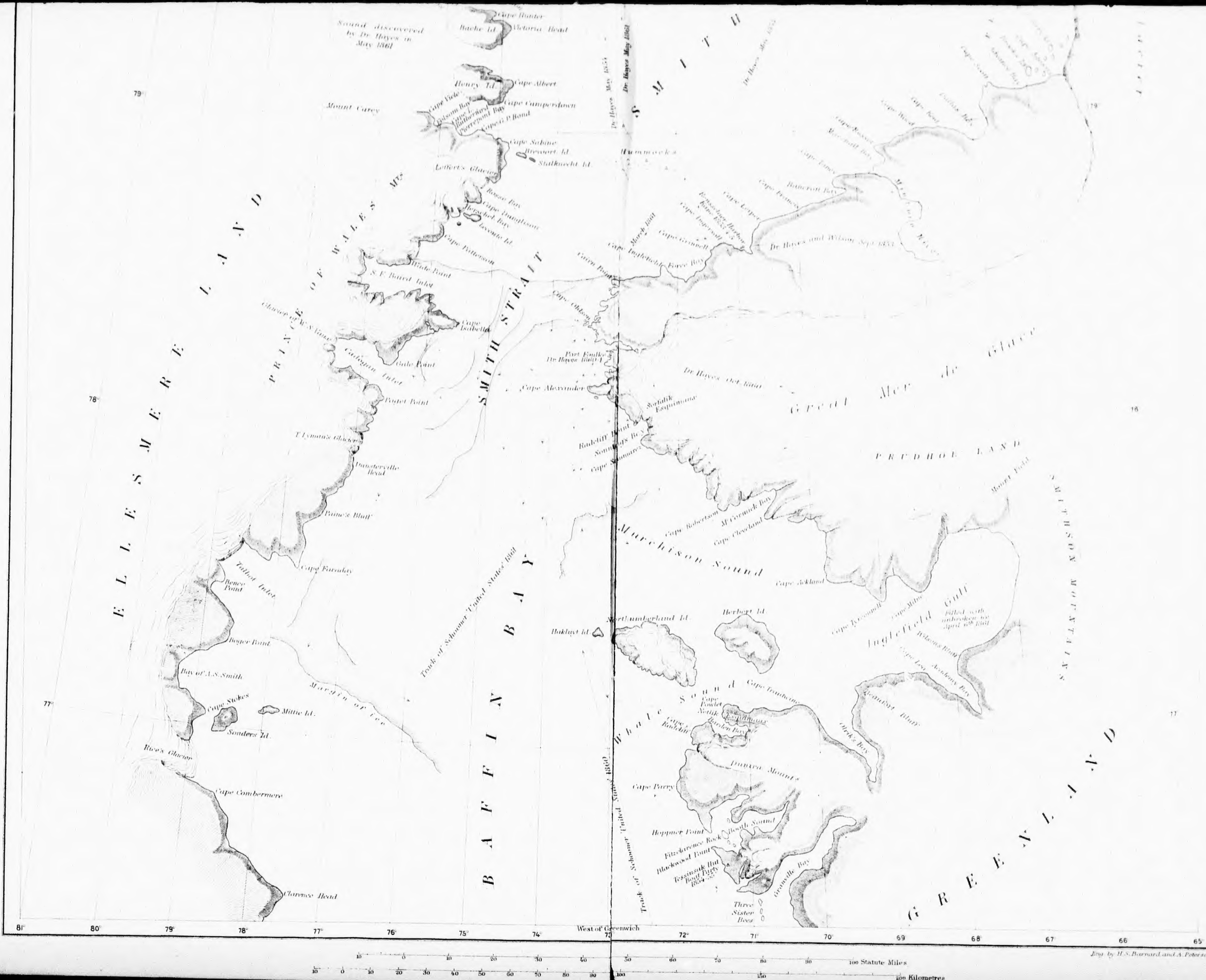
Joseph Henry

Secretary S. I.





75°
71°
69°
67°
65°
Cape Union
Lincoln Bay
Mount Parry
Cape Frederick VII
Wrangle Bay
Mount Beaufort
Cape Beechy
82°
Cape Murchison
Cape Bellot
Sylvia Mount
Lady Franklin Bay
Mount C. Grinnell
EYS
TION
ED FOR
Cape Cracroft
Church's Peak
Cape Defosse
Open Water June 27th 1854
Traces of Esquimaux
Mount Ross
Cape R. Baker
J. Harrison Bay
Cape Bucknell
Cape G. Back
Franklin Id.
Crozier Id.
81
Cape Constitution
Ward's Bluff
Carl Ritter Bay
Cape Independence
La Fayette Bay
Mount Rae
Cape L. von Buch
Cape Jefferson
Cape Lawrence
Cape Hamilton
Sir J. Richardson Bay
Cape Collinson
Mount Adams
Cape McClintock
Cape Madison
Scoresby Bay
Cape N. Shaw
Morris Bay
Traces of Esquimaux
Cape Calhoun
Cape Barrow
Maury Bay
Cape Wilkes
80
Hayes Farthest May 8th 1854 Kanes Exped.
K E N N E D Y   C H A N N E L
W A S H I N G T O N   L A N D
G R I N N E L L   L A N D
M O U N T A I N S
Mount C. E. Smith
Mount J. L. Stevens
Cape Fraser
Cape Jackson
Wright Bay
Cape Webster
Cass Bay
Cape Clay
Benton Bay
Cape Forbes
Cape Hayes
Cape L. Napoleon
Cape Prescott
Cape d'Urville
Hunter
Victoria Head
Cape Albert
Camperdown
Sabine
Brevoort Id.
Stalknecht Id.
Hummocks
Dr. Hayes May 1861
Dr. Hayes May 1854
S M I T H   S O U N D
P E A B O D Y   B A Y
Morton June, July 1854
Bonsall Oct. 1853
Cape McGary Id.
Cape Agassiz
Brooks Id.
Advance Bay
Cape Scott
Pallas Bay
Cape Kent
Cape Wood
Cape Russel
Marshall Bay
Cape Toney
Bancroft Bay
79°
Humboldt's Glacier
Cape Hunter



Sound discovered by Dr Hayes in May 1861
Cape Hawks
Bache Id.
Victoria Head
Henry Id.
Cape Albert
Mount Carey
Cape Camperdown
Cape Sabine
Brevoort Id.
Stalknecht Id.
Hummocks
SMITH
Dr Hayes May 1861
Leffert's Glacier
ELLESMERE LAND
PRINCE OF WALES MTS
SMITH STRAIT
Cape Isabella
Gale Point
Cadogan Inlet
Cape Alexander
Port Foulke
Great Mer de Glace
PRUDHOE LAND
Poyet Point
Lyman's Glacier
Dunsterville Head
Paine's Bluff
Cape Faraday
Talbot Inlet
Bence Point
Boyer Point
Bay of A.S. Smith
Cape Stokes
Mittie Id.
Sonders Id.
Rice's Glacier
Cape Combermere
Clarence Head
Track of Schooner "United States" 1861
Margin of Ice
BAFFIN BAY
Murchison Sound
Cape Robertson
Cape Cleveland
Cape Ackland
Northumberland Id.
Hakluyt Id.
Herbert Id.
Inglefield Gulf
Whale Sound
Cape Parry
Hoppner Point
Fitzclarence Rock
Blackwood Point
Booth Sound
Granville Bay
Three Sister Bees
SMITHSON MOUNTAINS
GREENLAND
81°
80°
79°
78°
77°
76°
75°
74°
73°
72°
71°
70°
69
68
67
66
65
West of Greenwich
100 Statute Miles
200 Kilometres
Eng. by H.S. Barnard and A. Petersen

PHILADELPHIA:
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CONTENTS.

PART IV.—METEOROLOGICAL OBSERVATIONS.

Temperature, at Port Foulke (Illustrations 1, 2, 3).

Atmospheric Pressure, at Port Foulke (Illustrations 4, 5, 6, 7).

Wind, at Port Foulke.

LIST OF ILLUSTRATIONS.

PLATES.

WOOD-CUTS.

INTRODUCTION.

The observations of which the record and results are given in the following pages were made during the expedition to the Arctic regions in 1860–61, under the command of Dr. Isaac I. Hayes. The principal objects of this expedition were to extend the exploration of Dr. Kane towards the north, and to make such observations of a scientific character as might tend to increase the existing knowledge of the Physical Geography, Meteorology, and Natural History of the region within the Arctic circle including the coasts and islands on either side of Smith's Straits.

The inception, organization, and equipment of the expedition were due to the energy and perseverance of Dr. Hayes, who succeeded in awaking a popular interest in the enterprise, and in obtaining the aid of scientific institutions and liberal individuals in carrying out his design. The larger part of the outfit was from voluntary contributions. The instruments were principally supplied by the Coast Survey, the Smithsonian Institution, and the Hydrographical Bureau of the Navy Department. The articles for collecting and preserving specimens of natural history were furnished by the Smithsonian Institution, the Academy of Natural Sciences of Philadelphia, and the Museum of Comparative Zoology at Cambridge, Mass. The original plan contemplated the employment of a small steamer and a schooner, but the means obtained were only sufficient to fit out a sailing vessel of 133 tons burthen, drawing eight feet of water. The party consisted of fifteen persons, exclusive of the commander, besides those engaged after the expedition arrived in Greenland. The astronomical, magnetical, and meteorological observations were principally under the direction of Mr. Augustus Sonntag, a native of Northern Germany, who had made himself favorably known by his scientific publications. He had accompanied Dr. Kane's expedition as astronomer and physicist, and, after his return, had made a magnetic and geographical survey in Mexico. He resigned the position of assistant in the Albany Observatory to join the expedition under Dr. Hayes, from which he was destined never to return.

The expedition left Boston harbor on the 9th of July, 1860, and, after sailing through a dense fog which continued seven days, or until after passing Cape Race, met with favorable winds which enabled it on the 30th of July to cross the Arctic circle. The first iceberg was seen July 23d, 8 P. M. Land was made on the 31st, and proved to be Disco Island. August 5th, at midnight, the explorers reached the Danish settlement Proven, on the western coast of Greenland. Disappointed in obtaining dogs, they put to sea again on the morning of August 12th, and on the same day were at Upernavik, the residence of the chief Danish trader. Here they

were detained four days in collecting dogs and procuring suitable garments of skins and furs to withstand the Arctic winter. Through the kindness of Mr. Hansteen, the governor, they obtained the services of three Esquimaux hunters, and also of a Dane as interpreter.

Leaving Upernavik, they were beset by an immense number of icebergs, some of them upwards of two hundred feet in height and a mile in length, the motion of which was principally due to the undercurrents, and therefore sometimes contrary to that of the wind. On the evening of August 21st they arrived at Tessuissak, also a Danish station, of which the geographical position was determined by Mr. Sonntag, where they obtained another supply of dogs.

From this place, they entered Melville Bay on the 23d of August. The wind had prevailed for several days from the eastward, and had apparently driven the ice towards the American side, opening before them a clear broad expanse of water. They did not meet with field ice until the 25th; through this they were so fortunate as to find an opening, and soon entered the northern water about twenty miles south of Cape Alexander, the jutting point on the Greenland side of Smith's Straits. This strait was entered on the 27th of August, but their efforts to find a navigable opening were interrupted by a heavy gale, which continued with great force for three days. It was not until after having been twice blown out that they effected a permanent lodgment in the straits on the second of September.

Failing to find an opening toward the west, they sought one higher up, near Cape Hatherton; but, when off Lyttleton Island, the schooner became so much damaged by collisions with the ice, that they were obliged to seek anchorage. They put to sea again on the 6th, but, failing to make headway, and the temperature having fallen to 12°, they were obliged to seek winter-quarters, which they found in Hartstene Bay, ten miles northeast of Cape Alexander. This was in a harbor to which the name of Port Foulke was given, in honor of one of the prominent patrons of the expedition. From subsequent observations this place was found to be in 78° 17′ 39″ north latitude, and longitude 73° 00′ 00″ west of Greenwich, twenty miles south of the latitude of Rensselaer Harbor, Dr. Kane's winter-quarters, and distant from it by the coast line about fifty-five st. miles.

In preparation for the winter, a house was built on shore to receive the stores, and the hold of the vessel was converted into a single room for the men. The deck was roofed over with boards brought from Boston for the purpose, and with these accommodations the ship's company lived in health and comfort during the winter. Game was found in abundance, the hunters rarely returning empty-handed. Reindeer in herds of ten and fifteen were frequently seen. The dogs, thirty in number, according to Esquimaux custom, were only fed every second day, and often devoured an entire reindeer at a single meal.

Soon after entering into winter-quarters an observatory was erected near the vessel, under the direction of Mr. Sonntag. It consisted of a wooden frame eight feet square and seven feet high, covered first with canvas, then with snow, and lined throughout with bear and deer skins. In this observatory the pendulum apparatus was vibrated for nearly a month; and on completing the series of observations with it, the magnetometer was substituted in its place. Near the observatory a

suitable shelter was also erected for the thermometers. These, which were mostly filled with spirits of wine, were in part a present from Mr. Tagliabue, of New York. They were observed, with the other instruments, each hour during the whole twenty-four every seventh day, and three times a day in the interval. In addition to these observations, the temperature was noted every second hour by a thermometer suspended from a pole on the ice.

In the autumn, Dr. Hayes, in connection with Mr. Sonntag, made a survey of a glacier which had been named by Dr. Kane "My Brother John's Glacier," and which is in a valley near the head of the bay in which the vessel was wintered. It was nearly two miles from the sea, which it is gradually approaching; and in order to determine its rate of progress, a base line was measured along its axis, from either end of which angles were taken to fixed objects on the mountain on each side. These measurements were repeated after an interval of eight months, and the result indicated a downward movement of ninety-four feet.

The sun was absent one hundred and thirty days, and during that long period of darkness the whole party enjoyed remarkably good health. This was in a great measure due to habits of regularity as to exercise and cleanliness enjoined on every member of the expedition, as well as to the abundant supply of fresh food. With the advance of winter, however, there came a serious misfortune, which almost paralyzed further effort; a disease which for several years had prevailed throughout Greenland broke out among the dogs, and before the middle of December the number of the pack was reduced to eleven. As the plan of extending the exploration was based on the use of these animals, it was absolutely necessary, at whatever cost of labor or expense of means, to obtain another supply, and for this purpose Mr. Sonntag volunteered to venture on a journey across the ice to a settlement of Esquimaux on the other side of Whale Sound. He started on this perilous enterprise on the 22d of December, accompanied by a young Esquimaux, and furnished with a sled drawn by nine dogs. In attempting to cross a wide crack in the ice which had but lately been frozen over, he fell in, was thoroughly wetted, and, before he could reach a place of shelter, was so chilled as to become insensible, and he died soon after. This event, which cast a profound gloom over the whole party, was a great loss to science. Mr. Sonntag had received a thorough mathematical education, was well trained in the use of instruments of precision, and, had his life been spared, would have extended the series of observations, and would have thus added to the value of the materials obtained. Fortunately he had completed the pendulum experiments, the principal astronomical determinations, commenced the magnetic and meteorological observations, and trained the assistants in the use of instruments. After his death, the observations were continued, under the immediate direction of the commander, by Mr. Radcliff, assisted by Mr. Starr and Mr. Knorr.

Having, in the spring, obtained from a band of Esquimaux which visited the vessel a new supply of dogs, some of which also died, leaving but two teams of seven each, a journey was made to establish a depot of provisions at the north, for use during the contemplated explorations in the opening of summer. Upon this occasion, Van Rensselaer Harbor, the winter-quarters of Dr. Kane, was visited, but no

vestige of the vessel which he had left there was seen. It had probably drifted out to sea with the ice, and subsequently been crushed and sunk.

The principal expedition from the vessel, which at first consisted of all the available members of the company, started on the fourth of April. It was furnished with a life-boat twenty feet long on runners, two teams of dogs, and provisions for seven persons for five months, and an additional supply for six persons and one team for six weeks. The intention was to cross directly over the ice of Smith's Straits to the western shore, and thence to continue the exploration northward as far as circumstances would permit; but this plan was frustrated by the condition of the ice and open water, which compelled them to travel along the eastern shore. The ice in the strait did not, however, improve as they advanced, but was crowded into ridges and hummocks more extensive than had ever before been seen; and finally, after three weeks' trial, it was found impracticable to transport the boat, prepared expressly for exploration in the polar water, across the straits, and Dr. Hayes was reluctantly obliged to send it back with most of the party, reserving for the further exploration three picked companions, two sleds, and fourteen dogs. With this reduction of force, the perilous journey was continued; but the hummocks became worse, and although the distance was only about forty miles in a direct line from the western coast, fourteen days were consumed in the journey.

The route they pursued was nearly the same as that followed in 1854 by Dr. Hayes under the direction of Dr. Kane, and an opportunity was thus afforded to make some important additions and corrections to the sketch of the shore line which had formerly been given. It was found that a channel or sound opening westward from Smith's Straits, separated Ellesmere Land from Grinnell Land, and that in the mouth of this sound are two large islands, to one of which the name of Bache, and to the other that of Henry was given. On the 12th of May Kennedy Channel was entered and the coast followed as it trends nearly due north to Ritter Bay. This point was reached on the 16th, when two of the party became exhausted by fatigue, and the exploration was continued for three days longer by Dr. Hayes and his assistant, Mr. George F. Knorr, and reached, May 18th, the latitude 81° 37′, about forty-one nautical miles beyond the limit of exploration under Dr. Kane and on the opposite side of the channel. To the highest point actually attained the name of Cape Lieber was given, and that of Church to a remarkable peak in the vicinity. On the north of Cape Lieber there opened a large bay, to which the name of Lady Franklin had been assigned by Kane; also on the north were seen a headland called Cape Beechey, and beyond another high point which was named, in honor of His Majesty the King of Denmark, Cape Frederick VII., and still farther in the distance a third projecting point was observed, which was designated Cape Union.

Returning upon the same track, the expedition reached the vessel after an absence of fifty-nine days, only seven dogs being alive, rendering further exploration in this way impracticable. The remainder of the time until the vessel was released from the ice was devoted to such surveys as could be made in the vicinity of Port Foulke, and the continuance of the observations of physical phenomena.

They were joined by a tribe of Esquimaux inhabiting the coast between Smith's

Strait and Cape York, numbering in all about eighty souls, who built snow-houses in the vicinity of the vessel, and maintained themselves by hunting the walrus and seal.

They sailed from the winter harbor on the 14th of July, and after much difficulty reached the west coast ten miles below Cape Isabella, and from an elevation of about six hundred feet Dr. Hayes obtained a view to the northward. In that direction the ice was everywhere unbroken, and as it did not appear probable that he could obtain for the schooner another harbor farther north, and as only five dogs remained without means of obtaining a new supply, he was reluctantly obliged to abandon the field, and direct his course homeward, trusting to be able at an early day to renew the exploration with a small steamer and under other more favorable conditions.

Entering Whale Sound, an excellent opportunity was presented for delineating the shore-line of that inlet; through a clear atmosphere the land from the north around to the south could be traced, thus proving the inlet to be a deep gulf which, in honor of the discoverer, was named the Gulf of Inglefield. Leaving Whale Sound and proceeding southerly, the survey was complete of north Baffin's Bay from Cape Alexander to Granville Bay. After laboriously working the way through "pack ice" for one hundred and fifty miles they entered the southern waters, and reached Upernavik on the 14th of August, and Disco Island on the 31st of August, being at both places kindly and hospitably received by the Danish officials.

At Godhaven they were informed by Inspector Olrik that he had received orders from his government to afford such aid to the expedition as was in his power, thus exhibiting that characteristic generosity and intelligent appreciation of science which marked its action towards all previous expeditions of a similar character.

Leaving Greenland they arrived in Boston, after a stormy passage, on the 23d of October, having been absent 15 months and 13 days.

During the whole cruise effort was constantly made to obtain specimens of geology and natural history, and though the party was small, valuable collections were obtained, embracing dredgings, plants, birds, and a large number of skulls of Esquimaux.

On the return of the expedition the records of the observations, excepting those relating to natural history, were given in charge to the Institution for reduction, discussion, and subsequent publication. They were placed in the hands of Mr. Chas. A. Schott, of the U. S. Coast Survey, and have been prepared by him for the press at the expense of the Smithsonian fund.

The foregoing sketch has been taken principally from the report of the lectures given by Dr. Hayes before the Institution in 1861. He has since, however, published a narrative in full, from which a minute account can be obtained of all the events of the expedition.

JOSEPH HENRY,
Secretary S. I.

SMITHSONIAN INSTITUTION

 June, 1867.

PART I.

ASTRONOMICAL OBSERVATIONS.

RECORD AND RESULTS

OF

ASTRONOMICAL AND GEODETIC OBSERVATIONS.

General Remarks.—The Arctic explorations made under the direction of Dr. Isaac I. Hayes, principally comprise the west coast of Smith Strait and Kennedy Channel, the existence of which had previously become known through the expedition under Dr. Kane, in the years 1853, '54, '55.

The scientific materials obtained by the expedition and referred to me for reduction and discussion by Professor Henry, Secretary of the Smithsonian Institution, are presented under the general heads of astronomical, magnetic, tidal, and meteorological observations.

The observations, especially the meteorological, are discussed on the same general plan as that adopted in the discussion of those of the expedition under Dr. E. K. Kane,[1] and also that under Sir J. L. McClintock,[2] as published by the Smithsonian Institution. The results, therefore, admit of the strict comparisons which have been made whenever practicable, and which give an additional interest and value to the series of publications of which this forms a part.

The present division under the title of Astronomical and Geodetic Observations, contains the determination of geographical positions, the results of surveys, and the pendulum experiments for relative force of gravity. Connected with this part is a large chart embracing the region of the exploration under Dr. Kane and that under Dr. Hayes, constructed from the additional materials collected by the latter, and also a smaller chart of the vicinity of Port Foulke, from original surveys.

The greater and more valuable portion of the observations was made by Mr. August Sonntag, astronomer and physicist to the expedition, and second in command. By his early death the expedition sustained a great loss, and we have espe-

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[1] Smithsonian Contributions to Knowledge: Magnetical, Meteorological, Astronomical, and Tidal Observations in the Arctic Seas, by Elisha Kent Kane, M. D., U. S. N., made during the second Grinnell expedition in 1853, 1854, and 1855; reduced and discussed by Charles A. Schott. Four parts, separately published in 1858, 1859, and 1860.

[2] Smithsonian Contributions to Knowledge: Meteorological Observations in the Arctic Seas, by Sir Francis L. McClintock, R. N., made in Baffin's Bay and Prince Regent's Inlet, in 1857, 1858, and 1859; reduced and discussed by Charles A. Schott. May, 1862.

cially to regret the scanty material for the determination of the longitude of Port Foulke. It was also his intention to have the pendulum experiments repeated during the following warm season.

The expedition was supplied with the necessary instruments; among these may be mentioned a prismatic reflecting circle, a Würdemann sextant, a vertical circle, and theodolite, all contributed by Prof. A. D. Bache; there were also three mean time (box) chronometers, one of these (No. 2007) an eight day chronometer. One of the chronometers was purchased from Willard, one hired from Bond, and one was lent free of cost by the brothers Negus; besides these Dr. Hayes purchased a pocket chronometer from Bond & Son; the pendulum was made by the same firm.

Reduction of the Observations.—The astronomical data required in the reduction were taken from the "American Ephemeris and Nautical Almanac."

All mere logarithmic work will be suppressed, but such intermediate results will be given which assist in forming a proper estimate of the value of the observations and of their treatment.

Separate results are in all cases preferred, unless the increased labor of computation counterbalances the advantage of comparability of individual results. They permit the recognition and consequent rejection of any defective observation in the series, and at the same time furnish the means of estimating or computing the probable uncertainty to which the final result may be subject. This, however, does not exclude the combination of a few readings to a mean reading or the arrangement of individual observations into groups, provided the interval of time is sufficiently short for second differences to have any appreciable effect. We may thus combine, in a measure, the advantages of the two methods.

The refractions have been computed from the tables in Captain Lee's "Collection of tables and formulæ, etc." They are Ivory's, and were considerably extended so as to meet the requirements of an arctic climate. I have preferred them to Bessel's, principally on account of their greater facility of application; they give a slightly higher value for very small altitudes.

Temperatures are recorded on Fahrenheit's scale, and the readings of the barometer are noted in inches and fractions of inches.

Mr. Sonntag had made preliminary computations of his observations which greatly facilitated the present reduction. It is to be understood that the observations were made by him, unless otherwise stated.

GEOGRAPHICAL POSITIONS.

Proven, North Greenland, Station near the Governor's House.

Observations for time, August 6th (A. M. 7th), 1860.

Double altitudes of the sun with Würdemann's sextant.

Index[1] $\begin{cases} -32' \ 5'' \\ +31 \ 35 \end{cases}$ Correction $-15''$

Pocket chronometer	$2\overline{\odot}$	Pocket chronometer	$2\odot$
$8^h\ 06^m\ 10^s$	$57^\circ\ 18'\ 00''$	$8^h\ 09^m\ 56^s$	$56^\circ\ 41'\ 35''$
06 54	23 10	10 27	44 20
07 36	28 20	11 17	50 20
	$2\underline{\odot}$		$2\odot$
8 08 19	56 30 20	8 11 57	57 57 10
08 55	34 15	12 23	58 01 00
09 21	37 05	13 09	06 00

Temp. $+48^\circ$ F., pressure $29^{in}.80$ at $+62$ F. Index $\begin{cases} -32' \ 20'' \\ +31 \ 25 \end{cases}$ Correction $-27''.5$

$$\left.\begin{array}{l} \text{Let } \phi = \text{latitude} \\ h = \text{altitude} \\ \delta = \text{declination} \\ t = \text{hour angle} \end{array}\right\} \text{then} \quad \cos t = \frac{\sin h - \sin \phi \sin \delta}{\cos \phi \cos \delta}$$

Approximate latitude 72° 23', approximate longitude $3^h\ 42^m$ west of Greenwich. The first column of the following table contains the mean chronometer time T, the second the altitude corrected for index error, refraction, parallax (in altitude), and semi-diameter. The refraction was computed for the first and last, and interpolated for the middle times. The third column contains the hour angle computed by the above expression; converting t into time and applying the equation of time, the chronometer correction ΔT was found as given in the last column. A $\begin{cases} + \\ - \end{cases}$ sign indicates chronometer $\begin{cases} \text{slow} \\ \text{fast} \end{cases}$ on local time; $\begin{cases} - \\ + \end{cases}$ indicates $\begin{cases} \text{gaining} \\ \text{losing} \end{cases}$ rate. For the first and last set $r = -1'\ 45''.9$ $\quad r_1 = 1'\ 44''.7$ $\quad \pi_1 = +7''.5$ and $\delta = +16^\circ\ 18'\ 8''$ for the middle.

T	h		ΔT
$8^h\ 6^m\ 53^s.3$	$28^\circ\ 23'\ 56''$	$-44^\circ\ 15'\ 13''$	$+1^h\ 01^m\ 33^s$
8 8 51.7	28 30 55	-43 44 43	36
8 10 33.3	28 36 41	-43 19 18	36
8 12 29.7	28 43 05	-42 50 52	34
			Mean, $+1$ 01 34.7

[1] To the reading *off* the arc I shall give the sign +, to that *on* the arc the sign —, in order to obtain at once the index correction. In the record the observer always notes the index *error* and the *correction* has therefore the opposite sign; in this paper the sign was at once changed. This note applies to the sextant as well as to the reflecting circle.

Double altitudes of the sun with reflecting circle.

Index $\left\{\begin{matrix} +32' \ 10'' \\ +32 \ \ 40 \end{matrix}\right. \quad \left.\begin{matrix} -30' \ 40'' \\ -30 \ \ 40 \end{matrix}\right\}$, correction $+52''.5$

Pocket chronometer.	$2\overline{\odot}$	Pocket chronometer.	$2\underline{\odot}$
8h 20m 51s	58° 55′ {20″ / 30}	8h 25m 03s	58° 19′ {60″ / 50}
8 21 48	59 01 {60 / 50}	8 25 40	58 23 {40 / 20}
	$2\underline{\odot}$		$2\overline{\odot}$
8 23 18	58 {08 40 / 07 40}	8 27 42	59 39 {40 / 20}
8 24 09	58 14 {40 / 10}	8 28 18	59 42 {60 / 40}

Index $\left\{\begin{matrix} +32' \ 30'' \\ +32 \ \ 40 \end{matrix}\right. \quad \left.\begin{matrix} -30' \ 40'' \\ -30 \ \ 20 \end{matrix}\right\}$, correction $+62''.5$

For the first and last set $r = -1'\ 42''.8$ $\quad r_1 = -1'\ 41''.1$ $\quad \pi_1 = +7''.5$ and $\delta = +16°\ 17'\ 57''$ for the middle.

T	h	t	ΔT
8h 21m 19s.5	29° 12′ 25″	−40° 37′ 33″	+1h 01m 37s
8 23 43.5	29 20 20	−40 00 48	40
8 25 21.5	29 25 33	−39 36 12	40
8 28 00	29 33 41	−38 57 29	37
		Mean,	+1 01 38.5

Observations for time, August 7th.

Double altitudes of the sun with reflecting circle and sextant.

Index correction +1′ 9″ $\qquad$ Reflecting circle.

Pocket chronometer.	$2\overline{\odot}$	Pocket chronometer.	$2\underline{\odot}$
2h 41m 58s	51° 04′ {40″ / 40}	2h 46m 23s	51° 32′ {40″ / 20}
2 42 47	50 57 {30 / 30}	2 47 26	51 23 {00 / 20}
	$2\underline{\odot}$		$2\overline{\odot}$
2 44 17	51 48 {40 / 50}	2 48 24	50 13 {10 / 20}
2 45 17	51 41 {20 / 20}	2 49 09	50 07 {20 / 00}

Index $\left\{\begin{matrix} +31' \ 20'' \\ -32 \ \ 00 \end{matrix}\right\}$ correction 20″ $\qquad$ Sextant.

Pocket chronometer.	$2\overline{\odot}$	Pocket chronometer.	$2\underline{\odot}$
2h 56m 41s	50° 09′ 40″	2h 58m 52s	48° 48′ 05″
57 18	05 00	2 59 40	42 00
57 50	00 40	3 00 09	37 50

T = + 51° $\quad$ B = 29in.8 at 60° $\qquad$ Index $\left\{\begin{matrix} +31' \ 20'' \\ -32 \ \ 05 \end{matrix}\right\}$ correction $-22''.5$

$r = -2'\ 01''$ $\quad r_1 = -2'\ 07''$ $\quad \pi_1 = +8''$ $\quad \delta = +16°\ 13'\ 31''$ and $+16°\ 13'\ 18''$ for first and last set.

T	h	t	ΔT
2h 42m 22s.5	25° 45′ 03″	54° 38′ 41″	+1h 01m 37s
2 44 47	25 35 25	55 15 07	38
2 46 54.5	25 26 49	55 47 34	40
2 48 46.5	25 19 34	56 14 31	36
2 57 16.3	24 44 38	58 23 43	43
2 59 33.7	24 34 59	58 58 43	46
		Mean,	+1 01 40.0

Observations for time, August 7th (A. M. 8th).

Double altitudes of the sun with reflecting circle.

Index $\left\{ \begin{matrix} +32 & 30'' & -30' & 0'' \\ +32 & 40 & -29 & 40 \end{matrix} \right\}$, correction $+1'\ 22''.5$

Pocket chronometer.	$2\underline{\odot}$	Pocket chronometer.	$2\overline{\odot}$
$8^h\ 21^m\ 05^s$	$57°\ 21'\ \left\{ \begin{matrix} 20'' \\ 50 \end{matrix} \right.$	$8^h\ 26^m\ 43^s$	$59°\ 01'\ \left\{ \begin{matrix} 20 \\ 20 \end{matrix} \right.$
8 22 16	$57\ \ 30\ \left\{ \begin{matrix} 30 \\ 00 \end{matrix} \right.$	8 27 39	$59\ \ 06\ \left\{ \begin{matrix} 20 \\ 10 \end{matrix} \right.$
	$2\overline{\odot}$		$2\underline{\odot}$
8 23 35	$58\ \ 41\ \left\{ \begin{matrix} 00 \\ 10 \end{matrix} \right.$	8 28 36	$58\ \ 10\ \left\{ \begin{matrix} 10 \\ 00 \end{matrix} \right.$
8 25 14	$58\ \ 51\ \left\{ \begin{matrix} 60 \\ 30 \end{matrix} \right.$	8 29 15	$58\ \ 13\ \left\{ \begin{matrix} 50 \\ 40 \end{matrix} \right.$

$T = +50°$, $B = 29^{in}.80$ at $63°$ Index $\left\{ \begin{matrix} +32' & 30'' & -30' & 30'' \\ +32 & 40 & -30 & 20 \end{matrix} \right\}$, correction $+1'\ 5''$

hence: $r = -1'\ 45''.3$ $r_1 = -1'\ 43''.6$ $\pi_1 = +7''.4$ and $\delta = +16°\ 00'\ 53''$ for the middle.

T	h	t	ΔT
$8^h\ 21^m\ 40^s.5$	$28°\ 57'\ 46''$	$-40°\ 28'\ 40''$	$+1^h\ 01^m\ 44^s$
8 24 24.5	29 06 25	-39 48 07	42
8 27 11	29 15 11	-39 06 40	41
8 28 55.5	29 20 47	-38 39 46	44
		Mean,	+1 01 42.7

Double altitudes of the sun with reflecting circle. Aug. 8th

Index $\left\{ \begin{matrix} +32' & 20'' & -30' & 40'' \\ +32 & 30 & -30 & 20 \end{matrix} \right\}$, correction $+57''.5$

Pocket chronometer.	$2\underline{\odot}$	Pocket chronometer.	$2\overline{\odot}$
$2^h\ 19^m\ 00^s$	$53°\ 26'\ \left\{ \begin{matrix} 40'' \\ 30 \end{matrix} \right.$	$2^h\ 22^m\ 22^s$	$54°\ 04'\ \left\{ \begin{matrix} 40 \\ 40 \end{matrix} \right.$
2 19 49	$53\ \ 20\ \left\{ \begin{matrix} 40 \\ 50 \end{matrix} \right.$	2 23 09	$53\ \ 58\ \left\{ \begin{matrix} 50 \\ 60 \end{matrix} \right.$
	$2\overline{\odot}$		$2\underline{\odot}$
2 20 43	$54\ \ 17\ \left\{ \begin{matrix} 20 \\ 00 \end{matrix} \right.$	2 24 02	$52\ \ 49\ \left\{ \begin{matrix} 20 \\ 00 \end{matrix} \right.$
2 21 33	$54\ \ 10\ \left\{ \begin{matrix} 40 \\ 30 \end{matrix} \right.$	2 24 36	$52\ \ 44\ \left\{ \begin{matrix} 40 \\ 60 \end{matrix} \right.$

$T = +52°$, $B = 29^{in}.80$ at $62°$ Index $\left\{ \begin{matrix} +32' & 40'' & -30' & 30'' \\ +32 & 30 & -30 & 10 \end{matrix} \right\}$, correction $+1'\ 07''.5$

hence: $r = -1'\ 54''.3$ $r_1 = -1'\ 55''.8$ $\pi_1 = +7''.6$ and $\delta = +15°\ 56'\ 38''$ for the middle.

T	h	t	ΔT
$2^h\ 19^m\ 24^s.5$	$26°\ 56'\ 24''$	$+48°\ 55'\ 03''$	$+1^h\ 01^m\ 33^s$
2 21 08	26 49 54	+49 21 09	34
2 22 45.5	26 43 51	+49 45 34	34
2 24 19	26 38 02	+50 08 40	33
		Mean,	+1 01 33.5

RECAPITULATION OF CORRECTION OF POCKET CHRONOMETER ON PRÖVEN TIME.

	ΔT
August 7th, 9 A. M.	$+1^h\ 01^m\ 34^s.7$
" 7th, 9 A. M.	38.5
" 7th, 4 P. M.	40.0
" 8th, 9 A. M.	42.7
" 8th, 3 P. M.	33.5
Mean,	+1 01 37.9

Observations for latitude, August 7th. Reflecting circle.
Circummeridian altitudes of the sun.

Index $\left\{\begin{matrix} +32' & 50'' & -30' & 50'' \\ +32 & 30 & 30 & 00 \end{matrix}\right\}$, correction $+1'\ 07''.5$

Pocket chronometer.	$2\overline{\odot}$	Pocket chronometer.	$2\underline{\odot}$
$10^h\ 50^m\ 07^s$	$68°\ 15'\ \begin{cases}50'' \\ 40\end{cases}$	$11^h\ 02^m\ 55^s$	$67°\ 17'\ \begin{cases}10'' \\ 20\end{cases}$
10 51 32	$68\ 17\ \begin{cases}20 \\ 40\end{cases}$	11 04 20	$67\ 17\ \begin{cases}00 \\ 10\end{cases}$
	$2\underline{\odot}$		$2\overline{\odot}$
10 54 02	$67\ 14\ \begin{cases}60 \\ 30\end{cases}$	11 05 52	$68\ 19\ \begin{cases}30 \\ 30\end{cases}$
10 55 10	$67\ 15\ \begin{cases}50 \\ 30\end{cases}$	11 07 08	$68\ 19\ \begin{cases}20 \\ 30\end{cases}$

$T = +54°$, $B = 29^{in}.80$ at $60°$ Index $\left\{\begin{matrix} +32' & 20'' & -30' & 40'' \\ +32 & 20 & -30 & 40 \end{matrix}\right\}$, correction $+50''$

Intermediate set of observations with W.'s sextant.

Index $\left\{\begin{matrix} +31' & 05'' & -32' & 00'' \\ +31 & 20 & -32 & 15 \end{matrix}\right\}$ Correction $-27''.5$

Pocket chronometer.	$2\underline{\odot}$	Pocket chronometer.	$2\overline{\odot}$
$10^h\ 56^m\ 57^s$	$67°\ 16'\ 20''$	$11^h\ 09^m\ 31^s$	$68°\ 19'\ 10''$
57 56	17 10	10 36	18 20
58 47	17 0	11 20	18 20
	$2\overline{\odot}$		$2\underline{\odot}$
10 59 47	68 19 30	11 12 32	67 14 50
11 00 52	19 20	13 42	14 15
11 01 41	20 15	14 27	14 10

We have, according to Gauss' method of reduction (Chauvenet's Spherical and Practical Astronomy, Vol. I, p. 244), with the assumed longitude $3^h.703$ west of Greenwich:—

$\delta =$ sun's declination at apparent noon . . . $= +16°\ 16'\ 05''.4$

$\delta_1 =$ " " mean " . . . $= +16\ 16\ 09.2$

$\Delta\delta =$ hourly increase of declination, $+$ for sun moving northward $= -42^s.3$

$\zeta_1 =$ meridian zenith distance $= \phi - \delta = 56°\ 06'\ 55''$

$\vartheta =$ hour angle of maximum altitude (in seconds of the chronometer) $=$ $[9.40594]\ \dfrac{\Delta\delta}{A}$; the angular brackets include a logarithm.

$A = k^1 \dfrac{\cos\phi \cos\delta}{\sin\zeta_1}$ for the sun and a mean time chronometer.

$k^1 =$ a tabular number having for its argument $\delta T - \delta E$, that is, the daily rate of the chronometer less the daily *increase* in the equation of time E, which is positive when additive to apparent time.

$\delta E = -7^s.4$, $\delta T = +1^s.5$, $k_1 = [0.00009]$, $A = +0.35004$ and $\vartheta = -30^s.8$.

$\phi = \zeta - Am + \delta_1 + y$ where m is a tabular number depending on the hour angle t^1 reckoned from the instant the sun reaches its maximum altitude, $-Am$ the reduction to the observed zenith distance and $y = A \dfrac{2 \sin^2 \frac{1}{2} \vartheta}{\sin 1''} = -0.''2$

Mean time of apparent noon			$+5^m$ $25^s.8$
Chronometer error	—1	01	39.3
Chronometer time of apparent noon	11	03	46.5
δ			—30.8
Chronometer time of sun's maximum altitude . . .	11	03	15.7

From reflecting circle, with $r = -1' \ 24''.6$ $\quad r_1 = -1' \ 24''.5$ $\quad n_1 = +7''$

T	h	$m.A$	$h + m.A$
10^h 50^m $49^s.5$	33° 51′ 41″	107″	33° 53′ 28″
10 54 36	33 52 36	52	28
11 03 37.5	33 53 35	0	35
11 06 30	33 53 07	7	14
			33 53 26

From sextant, with $r = -1' \ 26''.2$ $\quad r_1 = -1' \ 26''.2$ $\quad n_1 = +7''$

10^h 57^m $53^s.3$	33° 52′ 41″	20″	33° 52′ 61″
11 00 46.7	33 52 31	4	35
11 10 2.0	33 51 59	36	35
11 13 33.7	33 51 29	72	41
			33 52 43

Mean, by circle and sextant . . .	33	53	05
$90 + \delta_1 + y$	106	16	09
ϕ	72	23	04

This latitude was also determined by Kane, July 19, 1853, A. Sonntag, observer.[1] I found 72° 22′ 58″.

The mean of the two determinations, or 72° 23′ 01″, has been adopted as a reliable latitude of the Governor's house at Pröven.

Observations for longitude, August 7th.

Chronometer comparisons; $\Delta T = +1^h \ 01^m \ 37^s.9$ for pocket chronometer.

Chronometer.		Pocket chronometer.	Mean time.	ΔT
2007	5^h 13^m	0^h 30^m $47^s.6$	1^h 32^m $25^s.5$	-3^h 40^m $34^s.5$
1062	5 14	0 31 21.6	1 32 59.5	—3 41 00.5
740	5 15	0 32 29.5	1 34 07.4	—3 40 52.6

(N. B. Another comparison on the 6th shows the correctness of the above.)

The correction and rate of the three chronometers were determined at Boston, July 7, 1860, by Williard, as follows:—

Chronometer.	ΔT at Boston on Greenwich time.	Boston rate δT	ΔT on Greenw. time August 7.	ΔT on Pröven time August 7.	Long. of Pröven west of Greenwich.
2007	$+1^m$ $35^s.3$	$+0^s.4$	$+1^m$ $47^s.7$	-3^h 40^m $34^s.5$	3^h 42^m $22^s.2$
1062	+0 57.0	+0.2	+1 03.2	—3 41 00.5	3 42 03.7
740	+1 14.7	0.0	+1 14.7	—3 40 52.6	3 42 07.3
				Mean . . .	3 42 11.1

The longitude determined approximately by Kane, in 1853, was 3^h 42^m 30^s (see p. 41 of his Astronomical Observations).

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[1] Smithsonian Contributions, 1860: Kane's Astronomical Observations in the Arctic Seas, p. 36.

Port Foulke, Observatory, Smith Strait.

Port Foulke, a short distance to the northward and eastward of Cape Alexander, Smith Strait, was the winter quarters of the expedition during 1860–1861; the astronomical and magnetic observatory is situated at the head of the bay.

Observations for time. September 9th, 1860.

Double altitudes of the sun with reflecting circle.

Index $\begin{cases} +32' \; 50'' & -30' \; 20'' \\ +32 \;\; 50 & -30 \;\; 10 \end{cases}$ Correction $+1' \; 17''.5$

Pocket chronometer.	$2\underline{\odot}$	Pocket chronometer.	$2\overline{\odot}$
$4^h \; 09^m \; 01^s$	$24° \; 23' \begin{cases} 00'' \\ 00 \end{cases}$	$4^h \; 17^m \; 15^s$	$24° \; 45' \begin{cases} 50'' \\ 50 \end{cases}$
9 55	$24 \;\; 18 \begin{cases} 50 \\ 20 \end{cases}$	18 07	$24 \;\; 41 \begin{cases} 20 \\ 20 \end{cases}$
11 01	$24 \;\; 13 \begin{cases} 30 \\ 10 \end{cases}$	19 04	$24 \begin{cases} 37 \;\; 10 \\ 36 \;\; 30 \end{cases}$
	$2\overline{\odot}$		$2\underline{\odot}$
4 13 21	$25 \;\; 03 \begin{cases} 40 \\ 30 \end{cases}$	4 21 10	$23 \;\; 22 \begin{cases} 50 \\ 40 \end{cases}$
14 14	$25 \;\; 00 \begin{cases} 30 \\ 30 \end{cases}$	22 06	$23 \;\; 18 \begin{cases} 40 \\ 30 \end{cases}$
15 04	$24 \;\; 56 \begin{cases} 20 \\ 10 \end{cases}$	23 14	$23 \;\; 13 \begin{cases} 30 \\ 20 \end{cases}$

T = +26°.0, B = 29^{in} 80 at 62° Index $\begin{cases} +33' \; 0'' & -31' \; 00'' \\ +33 \;\; 0 & -30 \;\; 40 \end{cases}$ Correction $+1' \; 05''$

Assumed latitude 78° 17′ 39″, assumed longitude $4^h.865$ west of Greenwich.

Reducing these observations by the formula

$$\sin \tfrac{1}{2}t = \sqrt{\left(\frac{\sin \frac{1}{2}[\zeta + (\phi - \delta)] \, \sin \frac{1}{2}[\zeta - (\phi - \delta)]}{\cos \phi \cos \delta}\right)}$$

we have for each set: $r = -4' \; 32''.7$ $r_1 = -4' \; 40''.0$ $\pi_1 = + \; 8''.3$

T	ζ	δ	t
$4^h \; 12^m \; 06^s.0$	77° 44′ 12″	+5° 00′ 52″	+51° 08′ 18″
4 20 09.3	78 04 02	+5 00 45	+53 09 04

Converting into mean time and comparing with the chronometer time, we find the chronometer corrections:—

$-50^m \; 35^s.0$ and from second set

$-50 \;\; 35.2$

$\Delta T = -50 \;\; 35.1$

Observations for time, September 9th (10th A. M.). Strong wind, affecting the artificial horizon.

Double altitudes of the sun, with reflecting circle.

Index $\begin{cases} +32' \; 40'' & -31' \; 00'' \\ +33 \;\; 10 & -30 \;\; 30 \end{cases}$ Correction $+1' \; 5''$

Pocket chronometer.	$2\underline{\odot}$	Pocket chronometer.	$2\overline{\odot}$
$10^h \; 8^m \; 42^s$	$26° \; 55' \begin{cases} 30'' \\ 00 \end{cases}$	$10^h \; 14^m \; 29^s$	$28° \; 22' \begin{cases} 20'' \\ 00 \end{cases}$
9 25	$26 \;\; 59 \begin{cases} 60 \\ 40 \end{cases}$	15 02	$28 \;\; 24 \begin{cases} 40 \\ 00 \end{cases}$
10 07	$27 \;\; 02 \begin{cases} 50 \\ 40 \end{cases}$	15 42	$28 \;\; 26 \begin{cases} 40 \\ 30 \end{cases}$
	$2\overline{\odot}$		$2\underline{\odot}$
10 11 02	$28 \;\; 09 \begin{cases} 10 \\ 00 \end{cases}$	10 16 50	$27 \;\; 28 \begin{cases} 40 \\ 20 \end{cases}$
11 43	$28 \;\; 12 \begin{cases} 20 \\ 00 \end{cases}$	17 28	$27 \;\; 30 \begin{cases} 50 \\ 40 \end{cases}$
12 20	$28 \;\; 14 \begin{cases} 40 \\ 20 \end{cases}$	18 33	$27 \;\; 34 \begin{cases} 60 \\ 40 \end{cases}$

$T = +23^\circ.5,\ B = 29^{in}.50$ at 68° Index $\left\{\begin{matrix}+32' & 40'' & -30' & 50'' \\ +32 & 50 & -30 & 30\end{matrix}\right\}$ Correction $+1'\ 3''$

$r = -4'\ 02''.6$ $r_1 = -3'\ 59''.3$ $\pi_1 = +8''.3$

T	ζ	δ	t	E	ΔT
$10^h\ 10^m\ 33^s.2$	$76^\circ\ 15'\ 33''$	$+4^\circ\ 43'\ 48''$	$-39^\circ\ 08'\ 12''$	$-3^m\ 17^s.7$	$-0^h\ 50^m\ 23^s.7$
$10\ \ 16\ \ 20.7$	$76\ \ 04\ \ 22$	$+4\ \ 43\ \ 42$	$-37\ \ 41\ \ 00$	$-3\ \ 17.8$	$-0\ \ 50\ \ 22.5$

These observations were no doubt affected by the strong wind, the result will therefore not be used.

Observations for time, September 10.

Double altitudes of the sun, with reflecting circle.

Index $\left\{\begin{matrix}+32' & 40'' & -30' & 40'' \\ +32 & 40 & -30 & 20\end{matrix}\right\}$ Correction $+1'\ 5''$

Pocket chronometer	$2\underline{\odot}$	Pocket chronometer	$2\overline{\odot}$
$3^h\ 38^m\ 20^s$	$25^\circ\ 55'\begin{cases}20''\\00\end{cases}$	$3^h\ 42^m\ 56^s$	$26^\circ\ 38'\begin{cases}20''\\00\end{cases}$
39 00	$25\ \ 51\begin{cases}60\\30\end{cases}$	43 33	$26\ \ 35\begin{cases}40\\10\end{cases}$
39 36	$25\ \ 49\begin{cases}30\\20\end{cases}$	44 14	$26\ \ 32\begin{cases}40\\40\end{cases}$
	$2\overline{\odot}$		$2\underline{\odot}$
3 40 36	$26\ \ 48\begin{cases}30\\10\end{cases}$	3 45 07	$25\ \ 25\begin{cases}10\\20\end{cases}$
41 12	$26\ \ 45\begin{cases}40\\40\end{cases}$	45 40	$25\ \ 22\begin{cases}60\\50\end{cases}$
41 48	$26\ \ 42\begin{cases}40\\40\end{cases}$	46 22	$25\ \ 19\begin{cases}20\\00\end{cases}$

$T = +27^\circ.5,\ B = 29^{in}.50$ at 64° Index $\left\{\begin{matrix}+32' & 40'' & -31' & 00'' \\ +32 & 50 & -30 & 40\end{matrix}\right\}$ Correction $+57''$

hence: $r = -4'\ 12''.2$ $r_1 = -4'\ 15''.4$ $\pi_1 = +8''.3$

T	ζ	δ	t	E	ΔT
$3^h\ 40^m\ 05^s.3$	$76^\circ\ 54'\ 08''$	$+4^\circ\ 38'\ 34''$	$+43^\circ\ 13'\ 32''$	$-3^m\ 22^s.4$	$-0^h\ 50^m\ 33^s.6$
$3\ \ 44\ \ 38.6$	$77\ \ 04\ \ 09$	$+4\ \ 38\ \ 30$	$+44\ \ 22\ \ 42$	$-3\ \ 22.4$	$-0\ \ 50\ \ 30.2$
			Mean	. . .	$-0\ \ 50\ \ 31.9$

Observations for latitude, September 9th. Reflecting circle.

Circammeridian altitudes of the sun.

Index $\left\{\begin{matrix}+32' & 10'' & -31' & 20'' \\ +32 & 20 & -31 & 20\end{matrix}\right\}$ $\left\{\begin{matrix}+32' & 10'' & -31' & 20'' \\ +32 & 30 & -31 & 00\end{matrix}\right\}$ Correction $+31''.5$

(Applies to readings taken before $0^h\ 47^m$.)

Pocket chronometer	$2\underline{\odot}$	Pocket chronometer	$2\underline{\odot}$
$0^h\ 42^m\ 32^s$	$33^\circ\ 5'\begin{cases}30''\\40\end{cases}$	$0^h\ 52^m\ 23^s$	$33^\circ\ 5'\begin{cases}50''\\40\end{cases}$
43 19	$33\ \ 6\begin{cases}40\\30\end{cases}$	53 05	$33\ \ 5\begin{cases}50\\50\end{cases}$
44 35	$33\ \ 7\begin{cases}00\\00\end{cases}$	52 48	$33\ \ 5\begin{cases}40\\30\end{cases}$
	$2\overline{\odot}$		$2\overline{\odot}$
0 45 34	$34\ \ 10\begin{cases}20\\20\end{cases}$	0 55 17	$34\ \ 8\begin{cases}50\\30\end{cases}$
46 45	$34\ \ 10\begin{cases}50\\30\end{cases}$	55 59	$34\ \ 8\begin{cases}40\\30\end{cases}$
48 28	$34\ \ 10\begin{cases}00\\10\end{cases}$	56 38	$34\ \ 8\begin{cases}30\\20\end{cases}$

	$2\odot$		$2\odot$
$0^h\ 49^m\ 39^s$	$34^\circ\ 9'\ \begin{cases}50''\\40\end{cases}$	$0^h\ 57^m\ 25^s$	$33^\circ\ 4'\ \begin{cases}50''\\40\end{cases}$
50 24	$34\ \ 9\ \begin{cases}40\\30\end{cases}$	58 32	$33\ \ 4\ \begin{cases}20\\30\end{cases}$
51 24	$34\ \ 9\ \begin{cases}40\\30\end{cases}$	59 07	$33\ \ 4\ \begin{cases}00\\00\end{cases}$

$T = +28^\circ.0$, $B = 29^{in}.80$ at 62° Index $\left\{\begin{matrix}+\ \ \ \ 00'' & -30'\ 40''\\ +33\ \ 20 & -30\ \ 30\end{matrix}\right\}$ $\left\{\begin{matrix}+32'\ 40'' & -30'\ 50''\\ +32\ \ 50 & -30\ \ 40\end{matrix}\right\}$

$r = -3'\ 21''.8$ $\pi_1 = +8''.1$ Correction $+1'\ 09''$, applies after $0^h\ 47^m$

We have further—

$\delta = +5^\circ\ 04'\ 03''.3$	$\zeta_1 = 73^\circ\ 13'\ 36''$	$k^4 = [0.00024]$
$\delta_1 = +5\ \ 04\ \ 06.0$	$\delta T = +\ 3^s.2$	$A = 0.21119$
$\Delta\delta = -56''.87$	$\delta E = -20.6$	$\vartheta = -68^s.6$
		$y = -0''.5$

Mean time of apparent noon	$-0^h\ \ 2^m\ 59^s.3$
Chronometer error.	$+0\ \ 50\ \ 35.5$
Chronometer time of apparent noon	$0\ \ 47\ \ 36.2$
ϑ	$-0\ \ 1\ \ 08.6$
Chronometer time of sun's maximum altitude	$0\ \ 46\ \ 27.6$

T	h	mA	$h + mA$
$0^h\ 43^m\ 28^s.7$	$16^\circ\ 46'\ 09''$	$4''$	$16^\circ\ 46'\ 13''$
0 46 55.7	16 46 30	0	30
0 50 29.0	16 46 20	7	27
0 53 05.3	16 46 08	18	26
0 55 58.0	16 45 48	38	26
0 58 21.3	16 45 28	59	27
	Mean, rejecting first value		16 46 27
	$90 + \delta_1 + y$		95 04 06
	ϕ		$78\ \ 17\ \ 39 \pm 1''.8$

Observations for Longitude of Port Foulke.

The material for the determination of longitude is very scanty, and the separate results cannot be made to harmonize as well as is desirable. It was Mr. Sonntag's intention to observe as many eclipses of Jupiter's first satellite as could be procured; unfortunately of this class of observations there are but four now available. The chronometric determination is very unreliable, although the indications of the three chronometers kept tolerably well together as far as Pröven, we find them, a month later, diverging to the extent of four minutes; it is evident, therefore, that they sustained considerable disturbances in their rate, undoubtedly produced by the concussions of the vessel with waves and ice. A third way by which I hoped to obtain at least a closely approximate result is partly astronomical, partly geodetic. The meridian of Van Rensselaer Harbor, Dr. Kane's winter quarters in 1853–'54–'55, is well determined astronomically by moon culminations, eclipses, and occultations, and by adding the geodetic difference of longitude between the two observatories, as measured on the track chart, a longitude for Port Foulke was obtained more in excess of its most probable value as that by the chronometers was in defect. We have, therefore, to infer that the distance between Smith Strait and Van Rensselaer Harbor was overrated by Kane.

I proceed to give the numerical results by each of the three methods.

The following four eclipses[1] of Jupiter's first satellite were noted by the pocket chronometer:—

1860. November 18 (19th A. M.). Disappearance $11^h\ 05^m\ 55^s$. A. Sonntag, observer.
Jupiter much waving, time uncertain to 20^s.

1861. January 30 (31st A. M.). Disappearance $12^h\ 27^m\ 46^s$. H. G. Radcliff, observer.
Note as above.

1861. February 6 (7th A. M.). Disappearance $2^h\ 21^m\ 42^s$. H. G. Radcliff, observer.
Planet unsteady, time uncertain to 5^s.

1861. February 8. Disappearance $8^h\ 51^m\ 23^s$. H. G. Radcliff, observer.
Very slight snow falling, time uncertain to 20^s.

The same magnifying power of telescope was used in the above observations.

We have no comparisons of chronometers on November 18, and as the pocket chronometer was allowed to run down between October 31 and November 29, its rate is determined from observations on October 17 and October 31, and its correction from observations on November 29.

Observations for time, October 17th, 1860.

Double altitudes of α Lyræ, with reflecting circle.

Index $\left\{ \begin{matrix} +0'\ 40'' & +1'\ 40'' & +1'\ 00'' \\ +0\ \ 30 & +1\ \ 40 & +1\ \ 30 \end{matrix} \right\}$ Correction + 1′ 10″

Pocket chronometer	2*	Pocket chronometer	2*
$10^h\ 00^m\ 26^s$	84° 51′ {60″, 30}	$10^h\ 12^m\ 26^s$	83° 40′ {20, 20}
1 26	46 {00, 20}	13 19	34 {60, 50}
2 20	40 {10, 20}	14 18	28 {50, 50}
3 56	32 {20, 30}	15 30	22 {40, 30}
5 22	21 {20, 20}	16 43	16 {20, 10}
6 45	15 {20, 20}	17 45	8 {20, 10}
7 48	8 {20, 00}	18 56	0 {40, 50}
9 21	83 58 {10, 10}	20 13	82 54 {40, 30}
10 32	51 {70, 40}	21 02	49 {20, 00}
10 11 37	45 {30, 60}	22 08	42 {40, 60}

T = —2°, B = $29^{in}.390$ at 31° Index $\left\{ \begin{matrix} +1'\ 40'' & +1'\ 50'' & +1'\ 00'' \\ +1\ \ 40 & +1\ \ 40 & +1\ \ 10 \end{matrix} \right\}$ Corr'n + 1′ 30″

These observations will be combined two by two.

Refraction r for first observations — 1′ 10″.3, for last — 1′ 12″.9

Star's declination $\delta = +38^\circ\ 39'\ 34''.9$, right ascension $18^h\ 32^m\ 13^s.5$

The hour angle t is found from $\cos t = \dfrac{\sin h - \sin \phi \sin \delta}{\cos \phi \cos \delta}$

[1] Three other observations were found to be occultations of the satellite, not eclipses; they are of no value for our purpose.

Sidereal time at mean noon $13^h\ 45^m\ 38^s.5$; the sidereal time is converted into mean time, and ΔT is the chronometer correction on mean local time.

T	h	t	ΔT
$10^h\ 00^m\ 56^s$	42° 23′ 58″	66° 43′ 37″	$-48^m\ 57^s$
10 03 08	42 17 39	67 15 39	−49 01
10 06 03.5	42 08 39	68 01 10	−48 55
10 08 34.5	42 01 04	68 39 26	−48 54
10 11 04.5	41 53 54	69 15 31	−49 00
10 12 52.5	41 48 17	69 48 38	−48 56
10 14 54	41 42 19	70 13 31	−48 58
10 17 14	41 35 35	70 47 14	−49 03
10 19 34.5	41 28 17	71 23 40	−48 58
10 21 35	41 22 27	71 52 47	−49 03
		Mean . .	−48 $58.5 \pm 0^s.7$

Observations for time, October 31, 1860.

Double altitudes of α Lyræ, with reflecting circle.

Index $\begin{Bmatrix} +32'\ 00'' & -29'\ 20'' \\ +32\ \ 20 & -28\ \ 50 \end{Bmatrix}$ $\begin{Bmatrix} +1'\ 40'' & -1'\ 00'' \\ +1\ \ 40 & -0\ \ 40 \end{Bmatrix}$ Mean correction + 1′23″.8

Pocket chronometer	2 ✱	Pocket chronometer	2 ✱
$9^h\ 08^m\ 26^s$	84° 34′ {60″, 40}	$9^h\ 21^m\ 21^s$	83° 17′ {40′, 40}
09 26	29 {10, 00}	22 23	12 {60, 20}
10 40	22 {20, 10}	23 23	05 {40, 40}
11 29	16 {60, 40}	24 20	00 {20, 20}
12 57	08 {60, 40}	25 52	82 50 {40, 60}
14 02	01 {30, 40}	27 22	41 {40, 20}
15 12	83 55 {40, 20}	28 48	32 {60, 40}
16 39	47 {20, 20}	29 43	27 {40, 20}
18 13	36 {20, 20}	30 47	21 {40, 20}
19 15	30 {80, 40}	31 30	15 {60, 40}

T = + 1.°5, B = $27^{in}.744$ at 34° Index $\begin{Bmatrix} +32'\ 30'' & -28'\ 20'' \\ +32\ \ 40 & -28\ \ 20 \end{Bmatrix}$ $\begin{Bmatrix} +32'\ 20'' & -28'\ 00'' \\ +32\ \ 26 & -27\ \ 40 \end{Bmatrix}$

$r = -1'\ 10''\ 8$ and $r_1 = -1'\ 13''.7$ Mean correction + 2′ 11″.2

$\delta = +38°\ 39'\ 33''.3$

$\alpha = \ 18^h\ 32^m\ 13^s.2$

Sidereal time at mean noon $14^h\ 40^m\ 50^s.3$

T	h	t	ΔT
$9^h\ 08^m\ 56^s$	42° 15′ 42″	67° 25′ 26	$-49^m\ 13^s$
9 11 04.5	42 09 29	67 56 53	−49 16
9 13 29.5	42 02 18	68 33 00	−49 17
9 15 55.5	41 55 24	69 07 43	−49 24 rejected
9 18 44	41 46 32	69 52 19	−49 15
9 21 52	41 37 16	70 38 40	−49 18
9 23 51.5	41 31 11	71 08 51	−49 16
9 26 37	41 22 46	71 51 07	−49 14
9 29 15.5	41 14 45	72 30 59	−49 15
9 31 08.5	41 09 00	72 59 35	−49 13
		Mean . . .	−49 $15.2 \pm 0^s.7$

Hence rate of pocket chronometer between October 17 and October 31, $\delta T = -1.^s2$

Observations for time, November 29th, 1860.

Double altitudes of α Lyræ, with reflecting circle.

Index $\left\{\begin{matrix} +32' \ 40'' & -30' \ 30'' \\ +32 \ \ 40 & -30 \ \ 50 \end{matrix}\right\}$ Correction + 1′ 0

Pocket chronometer	2 ✱	
6ʰ 23ᵐ 50ˢ	84° 44′ {20″, 20}	
25 48	32 {20, 00}	T = + 21°
28 16	17 {20, 00}	B = 30ⁱⁿ.076 at 41°
30 55	02 {00, 00}	
32 19	83 53 {40, 40}	
35 17	36 {20, 00}	
38 43	40 {60, 40}	Index $\left\{\begin{matrix} +32' \ 20'' & -30' \ 40'' \\ +32 \ \ 00 & -30 \ \ 30 \end{matrix}\right\}$ Correction + 47″.5

$r = -1' \ 08''.4$ $r_4 = -1' \ 10''.1$

$\delta = +38° \ 39' \ 27''.6$

$\alpha = 18^h \ 32^m \ 12^s.8$

Sidereal time at mean noon $16^h \ 35^m \ 10^s.4$

T	*h*		Δ*T*
6ʰ 24ᵐ 49ˢ	42° 18′ 25″	67° 11′ 12″	— 5ˢ
6 29 35.5	42 04 05	68 24 20	— 1
6 33 48	41 51 45	69 25 43	— 7
6 38 43	41 37 12	70 38 27	—12
			— 6ˢ.3 ± 1ˢ.6

Hence Δ*T* November 19th,	+ 6ˢ
Satellite I, disappearance,	11ʰ 05ᵐ 55
Local mean time of eclipse,	23 06 01
Greenwich mean time,	27 57 12
Longitude Port Foulke,	4 51 11 west of Greenwich.

The correction of the pocket chronometer on local time, January 30th, is obtained by means of comparisons with the three mean time chronometers on that date, and the rates of these chronometers determined between November 29, 1860, and March 8, 1861.

Observations for time, March 8, 1861. S. J. McCormick, observer.

Altitudes of the sun. The times given are means of several observations, the corresponding mean altitudes are supposed corrected for index error.

Pocket chronometer	☉	
2ʰ 58ᵐ 25ˢ	4° 10′ 18″	T = —15°
3 00 50.5	4 05 39	B = 29ⁱⁿ.5 at 45°

$\pi = 8''$ $r = -12' \ 59''$ $r_1 = -13' \ 11''$

$\delta = -4° \ 38' \ 44''$ hence :—

ζ	*t*	*E*	Δ*T*
85° 46′ 25″	+40° 50′ 00″	+10ᵐ 51ˢ.3	—4ᵐ 13ˢ.7
85 51 16	+41 26 24	+10 51.3	—4 14.1
		Mean . . .	—4 13.9

Chronometer comparisons: November 29, 1860. Correction of pocket chronometer = — 6ˢ.3

Pocket chronometer.	Mean time.	Chronometers.	Correction on mean time.
8ʰ 18ᵐ 26ˢ.2	8ʰ 18ᵐ 19ˢ.9	2007 : 1ʰ 8ᵐ	—4ʰ 49ᵐ 40ˢ.1
19 44.9	19 38.6	1062 : 1 9	—4 49 21.4
20 43.2	20 36.9	740 : 1 10	—4 49 23.1

Chronometer comparisons: March 8, 1861. Correction of pocket chronometer — $4^m\ 13^s.9$

Pocket chronometer.	Mean time.	Chronometers.	Correction on mean time.
$3^h\ 38^m\ 37^s$	$3^h\ 34^m\ 23^s.1$	2007 : $8^h\ 22^m\ 20^s$	$-4^h\ 47^m\ 56^s.9$
3 39 11	3 34 57.1	1062 : 8 24 25	—4 49 27.9
3 39 35	3 35 21.1	740 : 8 25 45	—4 50 23.9

Rate, $\delta T = \frac{\Delta T - \Delta T_\odot}{99}$ for 2007 : $+1^s.04$

1062 :	— 0.07
740 :	— 0.62
Pocket chronometer,	— 2.50

Chronometer comparisons, January 31, 1861.

	ΔT Nov. 29.	δT	ΔT Jan'y 31.	Pocket chr. Jan'y 31.	Chron's Jan'y 31.	Mean time.	ΔT Pock. chr.
2007 :	$-4^h\ 49^m\ 40^s.1$	$+1^s.04$	$-4^h\ 48^m\ 35^s$	$0^h\ 24^m\ 40^s$	2007 : $5^h\ 10^m\ 27^s$	$+21^m\ 52^s$	$-2^m\ 48^s$
1062 :	—4 49 21.4	—0.07	—4 49 26	0 25 35	1062 : 5 12 27	+23 01	—2 34
740 :	—4 49 23.1	—0.62	—4 50 02	0 26 32	740 : 5 13 47	+23 45	—2 47
P. chr. :	— 06.3	—2.50					—2 44
					Mean . . .		—2 43

ΔT January 31, 1861	— $2^m\ 43^s$
Satellite I, disappearance	12 27 46
Local mean time of eclipse	12 25 03
Greenwich mean time	17 17 41
Longitude Port Foulke	4 52 38 west of Greenwich.

The local time for the two eclipses in February is obtained by means of chronometer comparisons on the 7th, and the rates of the chronometers and their corrections are previously determined.

Chronometer comparison February 7th, 1861.

Chronometers.	ΔT March 8.	ΔT Feb'y 7.	Pocket ch'r.	Mean time.	ΔT Pocket chr.
2007 : $7^h\ 27^m\ 36^s$	$-4^h\ 47^m\ 56^s.9$	$-4^h\ 48^m\ 27^s$	$2^h\ 42^m\ 15^s$	$2^h\ 39^m\ 09^s$	$-3^m\ 06^s$
1062 : 7 30 53	—4 49 27.9	—4 49 26	2 44 19.5	2 41 27	—2 53
740 : 7 33 39	—4 50 23.9	—4 50 05	2 46 40	2 43 34	—3 06
Pocket chr.	—0 04 13.9				—3 01
				Mean . . .	—3 01

Satellite I, disappearance	2 21 42
Local mean time of eclipse	14 18 41
Greenwich mean time	19 11 24
Longitude Port Foulke	4 52 43
Correction ΔT of pocket chronometer, February 8	—3 04
Satellite I, disappearance	8 51 23
Local mean time of eclipse	8 48 19
Greenwich mean time	13 39 52
Longitude Port Foulke	4 51 33

RECAPITULATION OF RESULTS FOR LONGITUDE OF PORT FOULKE FROM OBSERVED ECLIPSES OF JUPITER'S FIRST SATELLITE.

1860.	November 18	$4^h\ 51^m\ 11^s$
1861.	January 30	4 52 38
1861.	February 6	4 52 43
1861.	February 8	4 51 33
	Mean . . .	4 52 01 ± 16^s west of Greenwich.

The following time observations were reduced for the purpose of comparing the rates of the chronometers as found at Boston with rates determined at Port Foulke. The chronometer corrections are known from observations of September 9th, and of September 22d, 1860.

Observations for time, September 22d, 1860.

Double altitudes of α Lyræ, with reflecting circle.

Index $\left\{\begin{matrix} +1' \ 10'' & +0' \ 40'' & +0' \ 40'' \\ +1 \ \ 20 & +1 \ \ 00 & +0 \ \ 50 \end{matrix}\right\}$ Correction + 56.″7

Pocket chronometer.	2 *	Pocket chronometer.	2 *
10h 43m 58s	90° 12′ {90″ / 50}	11h 08m 24s	87° 59′ {00″ / 20}
10 45 55	90 02 {20 / 20}	09 29	52 {10 / 00}
10 48 15	89 49 {20 / 20}	10 35	45 {40 / 60}
10 49 45	40 {40 / 60}	11 47	39 {60 / 50}
10 51 37	31 {10 / 00}	12 40	33 {40 / 20}
10 52 48	24 {40 / 60}	14 01	26 {30 / 40}
10 54 12	17 {20 / 20}	15 33	17 {60 / 40}
10 55 23	10 {50 / 40}	16 50	09 {40 / 40}
10 56 57	02 {50 / 50}	17 53	04 {10 / 40}
10 58 20	88 55 {20 / 10}	18 45	86 58 {40 / 80}

Index between the two sets.

$\left\{\begin{matrix} +0' \ 40'' & +1' \ 10'' & +0' 20'' \\ +0 \ \ 50 & +1 \ \ 20 & +0 \ 30 \end{matrix}\right\}$

Correction +48″.3

Index at the close of the observations.

$\left\{\begin{matrix} +0' \ 50'' & +1' \ 20'' & +1' \ 20'' \\ +0 \ \ 40 & +1 \ \ 10 & 1 \ \ 20 \end{matrix}\right\}$

Correction + 66″.7

T = + 20°.7, B = 29in.72 at 58°

$r = -61''.6$ and $r_1 = -65''.0$

$\delta = +38° \ 39' \ 35''.1$

$\alpha = 18^h \ 32^m \ 14^s.2$

Sidereal time at mean noon $12^h \ 07^m \ 04^s.7$

T	*h*	*t*	Δ*T*
10h 44m 56s.5	45° 03′ 17″	+52° 39′ 59″	—50m 45s
10 49 00	44 51 57	53 43 09	—50 36
10 52 12.5	44 43 23	54 30 33	—50 40
10 54 47.5	44 36 25	55 08 48	—50 42
10 57 38.5	44 28 54	55 49 48	—50 50
11 08 56.5	43 57 14	58 40 10	—50 48
11 11 11	43 50 52	59 14 02	—50 47
11 13 20.5	43 44 26	59 48 03	—50 41
11 16 11.5	43 36 16	60 30 55	—50 41
11 18 19	43 30 15	61 02 30	—50 43
		Mean . . .	—50 43.3 ± 0s.9

Chronometer comparisons: September 9, 1860. Correction of pocket chronometer —50m 35s.1.

Pocket chronometer.	Mean time.	Chronometers.	Δ*T*
2h 27m 21s.5	1h 36m 46s.4	2007: 6h 29	—4h 52m 13s.6
28 25.3	1 37 50.2	1062: 6 27	—4 49 09.8
29 05.5	1 38 30.4	710: 6 28	—4 49 29.6

September 10, 1860. Correction of pocket chronometer $-50^m\ 31^s.9$

				Mean ΔT (9 & 10th)
$0^h\ 41^m\ 22^s.0$	$23^h\ 50^m\ 50^s.1$	2007 : $4^h\ 43^m$	$-4^h\ 52^m\ 09^s.9$	$-4^h\ 52^m\ 11^s.8$
41 25.2	50 53.3	1062 : 4 40	-4 49 06.7	-4 49 08.3
42 05.3	51 33.4	740 : 4 41	-4 49 26.6	-4 49 28.2

September 22, 1860.

				δT Port Foulke	δT Boston.	Adop[illegible] δ
$11^h\ 52^m\ 45^s.3$	$11^h\ 02^m\ 02^s.0$	2007 : $15^h\ 54^m$	$-4^h\ 51^m\ 58^s.0$	$+1^s.06$	$+0^s.4$	+[illegible].6
53 31.2	11 02 47.9	1062 : 15 52	-4 49 12.1	-0.29	$+0.2$	0.0
54 08.7	11 03 25.4	740 : 15 53	-4 49 34.6	-0.49	0.0	-0.2

The adopted rate is found by giving the weight ½ to the Port Foulke rate to make some allowance for the effect of the greater cold at this place. There are no means of obtaining sea rates for the chronometers.

We have accordingly the following chronometric results:—

ΔT July 7th on Greenwich time.	ΔT September 9th on Greenwich time.	ΔT September 9 & 10 On Port Foulke time.	Longitude of Port Foulke.
2007 : $+1^m\ 35^s.3$	$+2^m\ 14^s$	$-4^h\ 52^m\ 12^s$	$4^h\ 54^m\ 26^s$
1062 : $+0$ 57.0	$+0$ 57	-4 49 08	4 50 05
740 : $+1$ 14.7	$+1$ 02	-4 49 28	4 50 30
		Mean . . .	4 51 40 $\pm$ 56^s

A result to which we can attach but little value.

The determination of the longitude of Port Foulke by means of the known meridian of Van Rensselaer Harbor, and the geodetic difference of longitude with Port Foulke, involves as an intermediate step the position of Cairn Point if we wish to deduce the most reliable result. Cairn Point is the northern terminal cape of Smith Strait, as Cape Alexander is that of the southern, both located on the Greenland shore. At Cairn Point numerous measures were taken, important for the geography of the strait, besides it served as a point of departure for the northern journeys. Before, however, giving the astronomical observations at this point, the remaining time observations taken at Port Foulke, and required for the determination of the longitude of Cairn Point and other stations, will first be given.

Observations for time, Port Foulke, May 29th, 1861.

Altitudes of the sun. S. J. McCormick, observer.

Chronometer 2007	$\odot$	
$7^h\ 10^m\ 24^s$	$30^\circ\ 45'\ 40''$	T = + 32°
10 55	43 20	B = $29^{in}.72$ at 56°
11 30	42 30	Correction for index, dip, refraction and parallax = $-5'\ 04''$

N. B. Refraction very great when these sights were taken.

Semidiameter 15′ 48″

T	ζ	δ	t	E	ΔT
$7^h\ 10^m\ 56^s.3$	$59^\circ\ 05'\ 26''$	$+21^\circ\ 42'\ 40''$	$36^\circ\ 32'\ 10''$	$-2^m\ 52^s.6$	$4^h\ 47^m\ 40^s.6$

Altitudes of the sun, June 7th, 1861. S. J. McCormick, observer.

Chronometer 2007	$\odot$	
$7^h\ 58^m\ 12^s$	$30^\circ\ 09'\ 10''$	T = + 32°
58 43	08 10	B = $29^{in}.72$ at 54°
59 07	07 10	Corrections as above. Semidiameter 15′ 47″

Ordinary refraction

T	ζ	δ	t	E	ΔT
$7^h\ 58^m\ 40^s.7$	$59^\circ\ 41'\ 07''$	$+22^\circ\ 49'\ 09''$	$48^\circ\ 03'\ 26''$	$-1^m\ 25^s.3$	$4^h\ 47^m\ 52^s.3$

Altitudes of the sun, June 8th, 1861   S. J. McCormick, observer

Chronometer 2007	⊙	
$7^h\ 46^m\ 23^s$	$30^\circ\ 42'\ 50''$	T = + 34°
46 49	41 50	B = $29^{in}.69$ at 49°
47 16	41 00	Corrections as above. Semidiameter $15'\ 47''$

Ordinary refraction.

T		δ	t	E	ΔT
$7^h\ 46^m\ 49^s.3$	59 , 24″	$+22^\circ\ 54'\ 30''$	$45^\circ\ 02'\ 59''$	$-1^m\ 14^s.0$	$-4^h\ 47^m\ 51^s.3$

Altitudes of the sun, July 7th, 1861.   S. J. McCormick, observer

Chronometer 2007	⊙	
$7^h\ 59^m\ 05^s$	$30^\circ\ 4'\ 40''$	T = + 48°
59 41	2 30	B = $29^{in}.64$ at 58
8 00 34	0 30	Correction for index, dip, refraction, and parallax $-5'\ 07''.0$ Semidiameter $15'\ 46''.2$

	⊙
$8^h\ 01^m\ 17^s$	$29^\circ\ 58'\ 40''$
01 55	57 20
02 45	56 00

T	ζ	δ		E	ΔT
$7^h\ 59^m\ 46^s.7$	$59^\circ\ 46'\ 47''$	$+22^\circ\ 32'\ 46''$	$46^\circ\ 58'\ 4''$	$+4^m\ 36^s.4$	$-4^h\ 47^m\ 18^s.0$
8 01 59.0	59 52 01	+22 32 45	47 30 50	+4 36.5	−4 47 19.2
				Mean . . .	−4 47 18.6

Altitudes of the sun, July 13th, 1861.   S. J. McCormick, observer.

Chronometer 2007	⊙	
$7^h\ 58^m\ 50^s$	$29^\circ\ 20'\ 50''$	T = + 43°
59 30	19 00	B = $30^{in}.09$ at 57°
8 00 09	17 00	Correction for index, dip, refraction, and parallax $-5'\ 09''$

T	ζ	δ	t	E	ΔT
$7^h\ 59^m\ 29^s.7$	$60^\circ\ 30'\ 26''$	$+21^\circ\ 46'\ 03''$	$46^\circ\ 42'\ 56''$	$+5^m\ 26^s.5$	$-4^h\ 47^m\ 11^s.5$

Omitting the result of May 29th, on account of unusual refraction, we have the following chronometer corrections and rate:—

Port Foulke.	Chronometer 2007 Δ	δT
1861. March 8	$-4^h\ 47^m\ 56^s.9$	
1861. June 7	−4 47 52.3	$+0^s.6$
1861. June 8	−4 47 51.3	
1861. July 7	−4 47 18.6	+1 12
1861. July 13	−4 47 11.5	

The correction and rate of the pocket chronometer we obtain from the following chronometer comparisons. The pocket chronometer had run down March 18 and was set approximately to mean local time March 22.

Comparisons for the observations at Cairn Point.

Chronometer comparisons April 8th, 1861, at Port Foulke.

Pocket chronometer.	Chronometers.	ΔT Port Foulke.	Mean time Port Foulke.	ΔT Pocket chron'r on Port Foulke time.
$1^h\ 49^m\ 59^s.2$	740 : $6^h\ 33^m$	$-4^h\ 51^m\ 20^s.6$	$1^h\ 41^m\ 39^s.4$	$-8^m\ 19^s.8$
1 51 36.5	1062 : 6 33	−4 49 43.1	1 43 16.9	−8 19.6
1 53 24.2	2007 : 6 33	−4 47 55.1	1 45 04.9	−8 19.3
			Mean . . .	−8 19.6

$6^h\ 34^m\ 12^s$ of 2007 = $6^h\ 36^m$ of 1062

6 36 of 2007 = 6 39 $25^s.5$ of 740

3 May, 1865.

Chronometer comparisons, April 16th, 1861, at Port Foulke.

Pocket chronometer.	Chronometers.	ΔT Port Foulke.	Mean time Port Foulke.	ΔT Pocket chron'r on Port Foulke time.
$3^h\ 56^m\ 58^s.8$	2007: $8^h\ 36^m$	$-4^h\ 47^m\ 54^s.6$	$3^h\ 48^m\ 05^s.4$	$-8^m\ 53^s.4$
3 59 05.5	1062: 8 40	−4 49 47.6	3 50 12.4	−8 53.1
4 01 14.2	740: 8 41	−4 51 39.1	3 52 20.9	−8 53.3
			Mean . . .	−8 53 3

$8^h\ 43^m$ of 2007 = $8^h\ 44^m\ 53^s$ of 1062
8 45 of 2007 = 8 48 44.5 of 740

δT of pocket chronometer = $-4^s.2$

Cairn Point, Smith Strait.

Observations for latitude of Cairn Point, April 12th, 1861

Meridian altitude of the sun. S. J. McCormick, observer.

	2☉	
	40° 13′ 0″	T = −5°
Index correction +	2 0	B = $29^{in}.90$ at 66°
Altitude . . .	20 07 30	Approximate longitude $4^h\ 51\frac{1}{3}^m$ west of Greenwich.
Refraction—par. −	2 50	
Semidiameter . +	15 59	
Max. alt. . . .	20 20 39	
δ at appa't noon	8 51 23	
ϕ	78 30 42	Latitude of Cairn Point.

Observations for latitude of Cairn Point, April 15th, 1861

Meridian altitude of the sun. S. J. McCormick, observer

	2☉	
	42° 22′ 0″	T = −10°
Index correction +	2 0	B = $30^{in}.21$ at 56
Altitude . . .	21 12 00	
Refraction—par. −	2 44	
Semidiameter . +	15 59	
Max. alt. . . .	21 25 15	
δ at appa't noon	9 56 11	
ϕ	78 30 56	Latitude of Cairn Point.

The difference between the maximum altitude and the meridian altitude, owing to the change in the sun's declination, amounts in the present case to 0″.5, and may therefore be neglected.

Taking the mean value of ϕ we find the latitude of Cairn Point, 78° 30′ 49″

Observations for time and longitude of Cairn Point, April 15, 1861.

Double altitudes of the sun. S. J. McCormick, observer.

Pocket chronometer.	2☉	
$3^h\ 29^m\ 42^s$	33° 50′	T = −10°
30 36	46	B = $30^{in}.19$ at 55°
31 09	42	Index correction + 2′ 0″
r = 3′ 38″	π = 8″	Semidiameter = 15′ 58″

T	ζ	δ	t	E	ΔT
$3^h\ 30^m\ 29^s$	72° 53′ 32″	+9° 59′ 03″	50° 41′ 04″	-6^s	$-7^m\ 51^s$
		Pocket chronometer, ΔT on Port Foulke time,			−8 49.1
		Longitude of Cairn Point, east of Port Foulke,			0 58

Adopting the value $4^h\ 52^m\ 0^s$ for the longitude of Port Foulke, we have the longitude of Cairn Point $4^h\ 51^m\ 02^s$; the observer used a smaller difference of longitude from which I infer that the chronometer correction of the 8th was preferred with an average rate of $-2^s.5$, in this case we have ΔT on Port Foulke time $-8^m\ 37$, hence the latitude of Cairn Point $4^h\ 51^m\ 14^s$, which is adopted (see also determination from bearings further on).

Returning to the longitude of Port Foulke, by means of the known meridian of Van Rensselaer Harbor determined by Kane, we have the astronomical longitude of the latter place, as computed by me from moon culminations, occultations, and an eclipse[1] $4^h\ 43^m\ 31^s$, also Cairn Point west of Van Rensselaer Harbor by Kane's large track chart $11^m\ 32^s$, and by the above, Port Foulke west of Cairn Point 46^s; hence longitude of Port Foulke $4^h\ 55^m\ 49^s$, a result certainly too large, which can only be accounted for by an over estimation of the distance between Kane's winter quarters and Cairn Point; this apparent excess amounts to 13⅓ miles in linear measure; part of it, however, we must attribute also to the meridian adopted for each of the observatories.[2]

For the longitude of Port Foulke the value $4^h\ 52^m\ 00^s$ or 73° 00′ west has been adopted. The probable uncertainty of this value is one statute mile.

The following positions were determined by Dr. Hayes (or party) on his trip across the strait and up the west coast of Kennedy Channel in April and May. He started from Cairn Point April 20, 1861.

Camp Separation, SMITH SOUND.

Observations for latitude of camp, April 25th, 1861.

Meridian altitude of the sun. S. J. McCormick, observer.

$2\underline{\odot}$	48°	27′	00″	T = −12°
Index correction . +		1	00	B = $29^{in}.9$ at 51° as recorded at Port Foulke, it
Altitude . . .	24	14	00	answers as a rough approximation.
Refraction—par. . —		2	20	
Semidiameter . . +		15	55	Approximate longitude $4^h\ 48\frac{1}{2}^m$ west of Greenwich.
Maximum altitude	24	27	35	
δ at apparent noon	13	20	30	
φ	78	52	55	

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[1] Smithsonian Contributions, 1860: Kane's Astronomical Observations in the Arctic Seas, p. 33

[2] I have also attempted to work out a result for longitude from three observed double altitudes of the moon's lower limb February 17, 1861; the observations, however, were found too crude, the sextant reading was given to the nearest minute only

Camp Frazer, Smith Sound.

Observations for latitude of camp, May 14th, 1861.
Meridian altitude of the sun. Dr. I. I. Hayes, observer.

		2☉	
Pocket sextant[1] .		58° 16′	T = + 28°
Index correction .	—	1 28	B = 30in.3 at 67° approximately.
		56 48	Approximate longitude 4h 42½m
Altitude . . .		28 24.0	
Refraction—par. .	—	1.8	
Semidiameter . .	+	15.9	
Maximum altitude		28 38.1	
δ at apparent noon		18 44.4	
φ		80 06.3	

Farthest Camp, Kennedy Channel.

Observations for latitude of camp, May 17th, 1861.
Meridian altitude of the sun. Dr. I. I. Hayes, observer

		2☉	
Pocket sextant . .		56° 52′	T = + 22°
Index correction . .	—	1 31	B = 30in.0 at 53° approximately.
		55 21	Approximate longitude 4h 35½m
Altitude		27 40.5	
Refraction—par. .	—	1.8	
Semidiameter . .	+	15.8	
Maximum altitude .		27 54.5	
δ at apparent noon .		19 26.0	
φ		81 31.5	

Camp Leidy, Smith Sound.

Observations for latitude of camp, May 20th, 1861.
Meridian altitude of the sun. Dr. I. I. Hayes, observer.

		2☉	
Pocket sextant . .		61° 14′	T = + 22° (about)
Index correction .	—	1 30	B = 29in.7 at 52° approximately.
		59 44	Approximate longitude 4h 44m
Altitude		29 52.0	
Refraction—par. .	—	1.7	
Semidiameter . .	+	15.8	
Maximum altitude		30 06.1	
δ at apparent noon		20 04.6	
φ		79 58.5	

[1] This pocket sextant (Gilbert's No. 3) left in the same condition as on the return from the northern journey, was handed to me by Dr. Hayes for examination. I found the adjustment of the perpendicularity of the two mirrors quite perfect; the index error by means of a sharp vertical line, was 1° 30′ on the arc, and by means of four measures of twice the sun's diameter 1° 32′ on the arc, the correction was therefore —1° 31′.6. February 5, 1862.—Chas. A. S.

Deep Snow Camp, Smith Sound

Observations for latitude of camp, May 21st, 1861.

Meridian altitude of the sun, Dr. I. I. Hayes, observer

		2☉		
Pocket sextant .		61°	48′	T = + 22° (about).
Index correction .	—	1	32	B = 30in.0 at 60° approximately.
		60	16	Approximate longitude 4h 51m
Altitude		30	08.0	
Refraction—par. .	—		1.7	
Semidiameter . .	+		15.8	
Maximum altitude .		30	22.1	
δ at apparent noon		20	16.9	
φ		79	54.8	

Camp Hawks, Smith Sound.

Observations for latitude of camp, May 22d, 1861

Meridian altitude of the sun. Dr. I. I. Hayes, observe.

		2☉		
Pocket sextant . .		62°	34′	T = + 20° (about).
Index correction .	—	1	32	B = 30in.1 at 58 approximately.
		61	02	Approximate longitude 4h 53m
Altitude		30	31.0	
Refraction—par .	—		1.7	
Semidiameter . .	+		15.8	
Maximum altitude .		30	45.1	
δ at apparent noon .		20	28.8	
φ		79	43.7	

Small berg Camp, Smith Sound.

Observations for latitude of camp, May 23d, 1861.

The meridian altitude of the sun is recorded 2☉ 62° 58′ with a ? attached. As the resulting latitude is the same as that of the preceding camp, and the position of the camp on the track chart disagrees with it, I shall make no use of this observation.

Scouse Camp, Smith Sound.

Observations for latitude of camp, May 23d, 1861.

Meridian altitude of the sun, lower culmination.[1] Dr. I. I. Hayes, observer

		2☉		
Pocket sextant . .		21°	40′	T = + 18° (about).
Index correction	—	1	31	B = 29in.9 at 65° approximately.
		20	09	Approximate longitude 4h 52¾m
Altitude		10	04.5	
Refraction—par. .	—		5.5	
Semidiameter . .	+		15.8	
Minimum altitude .		10	14.8	
δ at apparent midnight		20	45.8	
φ		79	29.0	

[1] For upper culmination, $\phi = 90 + \delta - h$
For lower culmination, $\phi = 90 - \delta + h$

Determination of Longitudes for the Northern Journey.—These principally depend upon observed bearings of known headlands to the south, and some sextant angles. A few chronometric determinations depend upon the following chronometer corrections as found at Port Foulke, April 16th, and May 30th, and June 1st, 1861. For rate we are obliged to use the previously determined value, viz: $\delta T = -2^s.5$ since the pocket chronometer had evidently stopped more than an hour on or before May 13, occasioned by a neglect to wind at the proper time

April 16, 1861 ΔT at Port Foulke $= -8^m\ 53^s.3$

Chronometer comparisons, May 30th, 1861, at Port Foulke, two days after Dr. Hayes' return.

Pocket chro'r May 30.	Chronom'r 2007.	ΔT of 2007 June 7 and 8.	δT of 2007.	ΔT of 2007 May 30.	Mean time of comparison.	ΔT of pocket chr. May 30.
$9^h\ 00^m\ 51^s$	$3^h\ 1^m$	$-4^h\ 47^m\ 51^s.8$	$+0^s.06$	$-4^h\ 47^m\ 52^s.1$	$10^h\ 13^m\ 07^s.9$	$+1^h\ 12^m\ 16^s.9$

June 1.		June 1.	Mean time of comparison.	ΔT of pocket chr. June 1.	δT of pocket chronometer.
$7^h\ 34^m\ 56^s.2$	$1^h\ 35^m$	$-4^h\ 47^m\ 52^s.2$	$8^h\ 47^m\ 07^s.8$	$+1^h\ 12^m\ 11^s.6$	$-2^s.6$

Foggy Camp, SMITH SOUND.

Observations for longitude, May 13. I. I. Hayes, observer.

Pocket chronometer.	2⊙ by pocket sextant.		
$3^h\ 53^m\ 52^s$	$40°\ 37'$	Assumed latitude 79° 55′.5, longitude $4^h\ 47^m$	
	$2\overline{\odot}$	T = + 20° (about)	
3 58 48	42 28	B = $30^{in}.0$ at 51° approximately.	
3 59 52	42 22	Index correction — 1° 28′.0	
4 00 26	42 17	Refraction—par. 2′.7	
3 59 42	42 22.3	$h = 19°\ 58'.1$	$\delta = 18°\ 32'\ 18''$
		$t = 80\ \ 7'\ 10''$	$E = -3^m\ 53^s.4$

Mean time of observation,	$5^h\ 16^m\ 35^s$	
Chronometer time,	3 56 47	
ΔT	+ 1 19 48	
ΔT Port Foulke,	+ 1 12 58	Deduced from correction of May 30th.
Difference of longitude,	$6^m\ 50^s$	Foggy camp east of Port Foulke.
Longitude of Foggy camp,	$4^h\ 45^m\ 10$	(See determination from bearings further on.)

Camp Hawks, SMITH SOUND.

Observations for longitude, May 22. I. I. Hayes, observer.

Pocket chronometer.	2⊙ by pocket sextant.		
$7^h\ 09^m\ 55^s$	$29°\ 24'$	T = + 13° (about).	
11 17	19	B = $30^{in}.1$ at 58° approximately.	
12 05	14	Index correction —1° 32′.0	
7 11 06	29 19	Approximate longitude, $4^h\ 53^m$	
	$2\overline{\odot}$		
$7^h\ 13^m\ 05^s$	$30°\ 24'$	Refraction—par. —4′.0	
14 55	18		
7 14 00	30 21	$h = 14°\ 05'.0$	$\delta = 20°\ 32'\ 50''$
		$t = 127\ \ 39'\ 47''$	$E = -3^m\ 34^s.4$

Mean time of observation,	$8^h\ 27^m\ 05^s$	
Chronometer time,	7 12 33	
ΔT	+ 1 14 32	
ΔT Port Foulke,	+ 1 12 36	Deduced from correction of May 30th.
Difference of longitude,	+ 1 56	Camp Hawks east of Port Foulke.
Longitude of Camp Hawks,	4 50 04	(See determination from bearings further on.)

Magnetic Bearings for Position of Camps and Headlands.

The numerous magnetic bearings, taken at important positions on land and upon the ice, were made use of for the construction of a chart,[1] scale 1 : 1200 000. The chart depends upon the astronomical results just deduced; by means of these and a critical use of the bearings and sextant angles, the western shore line and that south of Smith Strait were finally laid down. All detail is taken from Dr. Hayes' original track chart (scale 1 : 600 000), to which I have closely adhered, as far as the above material would permit.

The longitude of Cairn Point, from observed bearings, is as follows:—

From bearings at Cairn Point,	72°	50′	Adopted longitude 72° 59′
" " " Littleton Island,	73	10	
" " " McGary Island,	73	05	
By chronometer,	72	48	

The longitude of Foggy Camp, from observed bearings, is as follows: 71° 33′, from chronometric determination 71° 17′ giving the former result the weight 2, the weighted mean becomes 71° 28′, which has been adopted.

The longitude of Camp Hawks from bearings is 73° 24′, from chronometric determination 72° 31′ giving the former result the weight 2, the weighted mean becomes 73° 06′ or $4^h\ 52^m\ 24^s$, which has been adopted.

Dr. Hayes reached Cairn Point May 27th, 3½ A. M., and Port Foulke May 28th, 10 A. M.

Survey of Smith Strait.

On the 27th of October, 1860, Mr. Sonntag measured a base line on the ice from the outer point of the third or Starr Island, near Port Foulke, bearing magnetically S. 4° 20′ W. The length of this base, from two measures with a 91 foot line, was 9097 feet, or 2772.9 metres. The position of Cape Isabella and of Cape Patterson, on the coast opposite, were determined from angles measured at the extremities of this base.

Readings of theodolite:—

						Mean.
At Third Island:	Base end,	193°	51′ 50	52′ 53	52½′ 53	193° 51′.9
	Cape Patterson,	312	43 44	45 47		312 44.8
	Cape Isabella,	348	13 15	13 15		348 14.0
At opposite end of base:	Third Island,	116	30 30	29 28	30 30	116 29.5
	Cape Isabella,	92	03 04	04 04	04 04	92 03.8
	Cape Patterson,	57	12 13	12 12		57 12.2

Solving the triangles:	Isabella,	1°	11′.8		Cape Patterson,	1°	49′.8
	Third Island,	154	22.5	and	Third Island,	118	52.9
	Base end,	24	25.7		Base end,	59	17.3

[1] See large chart accompanying this paper.

We find the distances:—

Third Island to Cape Isabella,	34.12 st. miles,	or 29.65 naut. miles.	
" " Cape Patterson,	46.39 "	40.30 "	

The latitude and longitude of these capes we deduce from the known position of Third Island,[1] viz: latitude 78° 17′ 45″, longitude 73° 06′ 00″, and the known variation, viz: $9\frac{3}{4}°$ west. Forming the spherical triangle pole, Third Island, Isabella (or Patterson) of which is given the colatitude of Third Island, the distance to Isabella (or Patterson) and the included spherical angle, we find—

Cape Isabella,	latitude	78° 22′.4	longitude	75° 30′.8
Cape Patterson,	"	78 46.1	"	75 30.5

We have also a direct determination of the latitude of Cape Isabella by Dr. Hayes, viz:—

Meridian altitude of sun, lower culmination, July 28th, 1861.

		2⊙		
Observed double alt.,	14°	1′	30″	T = + 49°
Index correction,		0	00	B = $29^{in}.9$ at 58°
Observed altitude,	7	0	45	
Refraction—par.,	—	7	17	
Semidiameter,	+	15	48	
Minimum altitude,	7	09	16	
δ at apparent midnight,	18	47	09	
φ	78	22	07	which agrees closely with the above geodetic latitude.

McGary Island, OPPOSITE LITTLETON ISLAND, SMITH STRAIT.

Observations for latitude of McGary Island, at southwest end of Island, July 6, 1861.

eridian altitude of the sun. I. I. Hayes, observer.

		2⊙		
	68°	04′	00″	T = + 42°
Index correction,	+	1	00	B = $29^{in}.4$ at 54
Altitude,	34	02	30	Assumed longitude $4^h\ 53\frac{1}{2}^m$
Refraction—par.,	—	1	20	
Semidiameter,	+	15	46	
Maximum altitude,	34	16	56	
δ at apparent noon,	22	39	59	
φ	78	23	03	Latitude of McGary Island.

On the 12th of June 1855, Kane[2] determined the latitude of Littleton Island and found 78° 22′ 01″. I adopt the mean of these determinations, or 78° 22′ 32″ for the channel between the two islands.

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[1] See accompanying chart of Port Foulke and vicinity, scale 1:170 000.

[2] Smithsonian Contributions, 1860: Kane's Astronomical Observations in the Arctic Seas, p 44.

Littleton Island, SMITH STRAIT

Observations for time and longitude, July 21 (22d A. M.), 1861.

Double altitudes of the sun. H. G. Radcliff, observer.

Chronometer 2007[1]	$2\overline{\odot}$
$3^h\ 34^m\ 03^s$	$62^\circ\ 42'\ 40''$
34 49	43 10
36 17	44 10
	$2\underline{\odot}$
3 39 00	61 50 00
39 57	51 40
41 14	54 10

T = + 34°
B = $29^{in}.6$ at 72°
Index correction + 1′ 04
Semidiameter 15 47
$r = 1'\ 37''$ $r_1 = 1'\ 39$
$\pi = 8''$

T	ζ	δ	t	E	ΔT
$3^h\ 35^m\ 03^s.0$	$58^\circ\ 55'\ 04''$	$20^\circ\ 13'\ 24''$	$-19^\circ\ 59'\ 39''$	$+6^m\ 07^s.6$	$-4^h\ 48^m\ 54^s.1$
3 40 03.7	58 49 14	20 13 22	−18 39 26	+6 07.6	−4 48 33.8
			Mean . . .		−4 48 44

Observations for time and longitude, July 26th, 1861

Chronometer 2007.[2]	Corrected alt. ☉
$7^h\ 51^m\ 10^s$	$27^\circ\ 33'\ 50''$
53 19	27 28 55
58 12	27 18 01
8 02 21	27 08 31
04 53	27 02 43
06 49	26 57 42

T = + 44°
B = $29^{in}.88$ at 55

T	ζ	δ	t	E	ΔT
$7^h\ 59^m\ 27^s.3$	$62^\circ\ 45'\ 03''$	$19^\circ\ 20'\ 06''$	$45^\circ\ 16'\ 20''$	$+6^m\ 11^s.5$	$-4^h\ 49^m\ 03^s.2$

Longitude of Littleton Island

	ΔT Litt. Island.	ΔT Port Foulke.	Litt. Is. west.
1861, July 21	$-4^h\ 48^m\ 44^s$	$-4^h\ 47^m\ 02^s$	$1^m\ 42^s$
1861, July 26	−4 49 03	−4 46 57	2 06
Mean . . .			1 54

If we reject the second set of observations on the 21st, the two results for difference of longitude become $1^m\ 52^s$ and $2^m\ 06^s$, the mean $1^m\ 59^s$ is adopted. The longitude of Littleton Island becomes therefore $4^h\ 53^m\ 59^s$, which agrees well with the geodetic determination, for which see chart of Port Foulke and vicinity.

This chart puts Cape Alexander in latitude 78° 10′.5. Dr. Kane found, June 17, 1855, the latitude 78° 09′.3, a result which agrees well enough with the chart.

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[1] The chronometer minutes have been changed from 35^m to 34^m.

[2] The above times are the observed times $-3^m\ 07^s.3$, by which correction the observer intended them to represent Greenwich time.

Gale Point, NEAR CAPE ISABELLA, SMITH STRAIT.

Observations for latitude at anchorage off Gale Point, July 27, 1861.[1]

Meridian altitude of the sun. S. J. McCormick, observer.

Gale Point bears S. W (true), and Cape Isabella N. E. by N. (true).

Observed altitude ☉	30°	45′	40″	Approximate longitude $5^h\ 5^m$
Dip and index correction, —		3	19	
	30	42	21	
Refr'n—par.	—	1	30	
Semidiameter,	+	15	48	
True altitude,	30	56	39	
δ at apparent noon,	19	08	08	
φ	78	11	29	

Observations for longitude, sights taken from a grounded iceberg off Gale Point.

Double altitudes of the sun. S. J. McCormick, observer July 28 (29th A. M.)

Pocket chronometer			2☉			
2^h	39^m	58^s	55°	29	30″	T = + 50°, B = $29^{in}.8$ at 54° } about
	40	22		31	50	
	40	56		34	40	Approximate longitude, $5^h\ 6^m$
			2☉			Index correction, 0′ 0″
2	41	25	55	36	00	Refr.—par. —1′ 42″
	42	03		38	20	Semidiameter, +15′ 48″
	42	27		39	50	$h = 28°\ 01'\ 37''$ $\delta = 18°\ 41'\ 35''$
						$t = -36°\ 19'\ 00''$ $E = +6^m\ 10^s$

Chronometer time of observation,	2^h	41^m	11^s	
Reduction[2] to refer pocket ch'r to ch'r 2007,		—1	33	
(2007) Chronometer time of observation,	2	39	38	
Mean time of observation,	21	40	54	
Δ*T* off Gale Point,	—4	58	44	
Δ*T* Port Foulke,	—4	46	55	(see preceding table of Δ*T* and δ*T* of 2007)
Iceberg off Gale Point, W. of Port Foulke,		11	49	
Longitude of position,	5	03	49	west of Greenwich

The following observations on Upper Baffin Bay conclude the series of geographical positions:—

Netlik, SOUTHERN ENTRANCE TO WHALE SOUND.

Observations for latitude at north point of harbor, close to Esquimaux huts, August 5, 1861.

Meridian altitude of the sun. S. J McCormick, observer.

2☉	59°	01′	20″	
Index correction,		0	00	T = + 47° } about
Altitude observed,	29	30	40	B = 29^{in} 9 at 50° }
Refr'n—par.,	—	1	35	Approximate longitude, $4^h\ 46^m$
Semidiameter,	+15		49	
h	29	44	54	
δ at apparent noon,	16	52	40	
φ	77	07	46	

[1] There is some doubt about the date; the record gives 28th, but the statement that the position is about 10 miles south of Cape Isabella and the plotted position on the track chart, accord well with the corrected date, and with the above resulting latitude.

[2] Chronometer comparison: 2007, $6^h\ 34^m$, Pocket chronometer $6^h\ 35^m\ 33^s.2$.

Observations for longitude, August 4 (5th A. M.).

Double altitudes of the sun. S. J. McCormick, observer.

	Pocket chronometer.	2☉	
	2h 20m 17s	53° 33′ 30″	T = + 38° } about
	20 49	34 40	B 29in.9 at 50° } about
	21 07	36 10	Index correction 0′ 0″
Mean,	2 20 44	53 34 47	Refr'n—par. — 1′ 50″
Reduction[1] to 2007,	— 1 50		Semidiameter + 15′ 49″
T	2 18 54		h = 27° 01′ 22″ δ = — 16° 54′ 21″
			t = —36 42 10 E = + 5m 41s

Mean time of observation,	21h 38m 50s	
Chronometer time,	26 18 54	
Δ *T* Netlik,	—4 40 04	
Δ *T* Port Foulke,	—4 46 36	(see preceding table of Δ *T* and δ *T* of 2007)
Netlik east of Port Foulke,	6 32	
Longitude of Netlik,	4 45 28	west of Greenwich.

Upernavik, North Greenland.

Observation for latitude, August 16, 1861.

Meridian altitude of the sun. S. J. McCormick, observer.

2☉	61° 13′ 50″	
Index correction,	0 00	T = + 51°
Altitude observed,	30 36 55	B = 29in.9 at 51°
Refr.—par.,	— 1 30	Assumed longitude 3h 44m
Semidiameter,	+ 15 51	
h	30 51 16	
δ at apparent noon,	13 38 03	
ϕ	72 46 47	

Dr. Kane, in 1853, found this latitude 72° 46′ 12″ (Sonntag observer; see p. 37 of Kane's Astronomical Observations); according to Captain Inglefield the latitude is 72° 46′ 51″; the mean of the three determinations is 72° 46′ 37″.

Observations for time at Upernavik, August 15, 1861.

Double altitude of the sun. S. J. McCormick, observer.

	Chronometer 2007	2☉		
	6h 35m 24s	52° 00′ 30″	T = + 50°	
	35 59	51 57 20	B = 29in.9 at 54°	
	36 24	51 54 40	Index correction, 0′ 00″	
	36 53	51 50 50	Refr'n—par., — 1 40	
	37 20	51 48 20	Semidiameter, + 15 50	
	37 43	51 45 30		
	38 07.5	51 42 10	h = 26° 09′ 01″	δ = + 13° 54′ 52″
	38 30.5	51 40 50	t = 42 45 10	E = + 4m 10s
Mean,	6 37 02.8	51 50 01		

[1] Chronometer comparison: 2007, 7h 42m, Pocket chronometer, 7h 43m 50s.

Mean time of observation	2^h	55^m	11^s
Chronometer time[1]	6	34	41
ΔT.	—3	39	30
ΔT Port Foulke	—4	46	35
Difference of long. Port Foulke and Upernavik	1	07	05
Longitude of Upernavik according to Inglefield	3	44	11
Longitude of Port Foulke	4	51	16 west of Greenwich.

(If the times had been noted by 2007, this longitude would be smaller by 2^m 22^s).

These time observations at Upernavik I have introduced to show that their tendency is still more to lessen the adopted longitude of Port Foulke, or else to increase the adopted longitude of Upernavik; placing but little confidence in the result, I make no further use of it.

Recapitulation of Preceding Results for Geographical Positions.

Locality.	Latitude.	Longitude west of Greenwich. In arc.	Longitude west of Greenwich. In time.
Port Foulke, Observatory, Smith Strait .	78° 17′ 39″	73° 00′ 00″	4^h 52^m 00^s
Littleton Island, Smith Strait	78 22.5	73 29 45	4 53 59
McGary Island, " "	78 23.1	- - - - - - - -	- - - - - - -
Cairn Point, " "	78 30 49	72 59	4 51 56
Cape Isabella " "	78 22 15	75 30.8	5 02 03
Off Gale Point, " "	78 11.5	75 57.2	5 03 49
Cape Patterson, " "	78 46.1	75 30.5	5 02 02
Camp Separation, Smith Sound	78 52 55	- - - - - - - -	- - - - - - -
Foggy Camp, " "	- - - - - - - - -	71 28	4 45 52
Camp Frazer, " "	80 06.3	- - - - - - - -	- - - - - - -
Farthest Camp, Kennedy Channel . .	81 31.5	- - - - - - - -	- - - - - - -
Camp Leidy, Smith Sound	79 58.5	- - - - - - - -	- - - - - - -
Deep Snow Camp, " "	79 54.8	- - - - - - - -	- - - - - - -
Camp Hawks,[2] " "	79 43.7	73 06	4 52 24
Scouse Camp, " "	79 29.0	- - - - - - - -	- - - - - - -
Netlik, Whale Sound	77 07.8	71 22.0	4 45 28
Upernavik, Upper Baffin Bay	72 46 37	- - - - - - - -	- - - - - - -
Pröven, Governor's house	72 23 01	55 32 45	3 42 11

[1] I suspect that the above times were noted by the pocket chronometer, and not by 2007. I have, therefore, subtracted 2^m 22^s to refer to 2007.

[2] On the unrevised track chart of Dr. Kane's the cape, forming the southern promontory of Dobbin Bay, is named after Dr. I. I. Hayes; but on the chart accompanying Dr. Kane's narrative of his expedition (see Vol. I) the cape appears as Cape Hawks, and the more northern and eastern cape, where Dr. Hayes first made the west coast of Smith Sound, is inscribed with the discoverer's name. This last designation was retained on the Smithsonian chart accompanying the astronomical observations of the Kane expedition, and is adhered to now with the approval of Dr. Hayes.

PENDULUM EXPERIMENTS.

The pendulum observations were made for the purpose of ascertaining the relative force of gravity at Cambridge, Massachusetts, and at the winter quarters of the expedition in North Greenland. The pendulum was expressly made for the occasion by Bond & Son, Boston. It is an invariable, reversible, brass pendulum, perfectly symmetrical in all its parts, as shown in the annexed figure. It is very nearly synchronous, though not convertible, as its form at once indicates. Its total length is 5 feet $7\frac{3}{4}$ inches, width 1.4, and thickness 0.7 inches; distance between the knife-edges 39.4 inches. The steel knife-edges are 14.2 inches from the ends of the bar, 3 inches long, 0.3 inches high, and 0.27 inches wide at the base; their section is triangular. The weight is 21.92 pounds, hence its specific gravity $8\frac{1}{2}$ nearly. The knife-edge, which runs through a perforation of the bar, rests upon steel plates. They are screwed to a brass plate, and supported by a heavy block of wood, which is fastened to the case in which the pendulum swings. There is no adjustment for horizontality of the supporting steel plates other than what is given by the vertical position of the case. The arc of vibration is read off on a scale at the bottom of the case, which has a glass door in front permitting a view of the whole pendulum. Two thermometers are permanently fastened inside the box, one just above the support, the other on a level with the swinging knife-edge.

$\frac{1}{10}$ of real size.

There is a preliminary reduction of the observations at both stations by Mr. Sonntag; the present independent reduction differs from it by a more complete and critical use of the materials; no attempt, however, of combining the resulting number of vibrations at the two stations had been made by Mr. Sonntag.

The following explanatory note is extracted from the record of the experiments at the Harvard College Observatory:—

"Pendulum suspended in transit room of Observatory of Harvard College, Cambridge, and its vibrations observed by G. P. Bond, Director, and T. H. Safford, Assistant."

In the following pages are the times read off from the record sheet of the electric register. The signals always commence with the transit of a mark on the pendulum from *right* to *left*, seen in the telescope (which does not invert). Different marks were used for different sets,[1] but the same mark was always observed both right (R.) and left (L.).

[1] Owing to defective illumination the point first selected, which was the knife-edge, could not always be seen, and others were taken—all of them near the axis.

The pendulum vibrates nearly at mean solar time, temperature at 71° Fah.

The register clock gained daily $2^s.9$ on sidereal time.

The "arc" denotes the angle between the extreme right and left positions of the pendulum.

The geological formation is drift overlying the silurian rocks.

Pendulum Experiments.

Vibrations observed at the Observatory of Harvard College, Cambridge, Massachusetts, July 3 and 4, 1860.[1]

G. P. Bond, Director of Observatory, observer.

July 3, 1860. No. 4 faces telescope and swings.

Time	Seconds		Remarks
	R.		
$13^h\ 57^m$	$15^s.2$		at $12^h\ 5^m$ upp. ther. 72° 8 F.
	17.2		low. " 69.8
	19.2		observer, G. P. B.
	21.2		
	23.2	×	
	25.2		
	27.2		
	29.3		
	31.2		
	33.2		
	L.		
13 57	38.2		
	40.2		
	42.3		
	44.3		
	46.3		
	48.2	×	
	50.2		at $13^h\ 59^m$ arc 3°.10[2]
	52.2		
	54.3		
	56.3		
	58.2		
58	00.3		
	R.		
14 06	52.8		
	54.8		
	56.8		
	58.8		
07	00.8		at $14^h\ 7^m$ arc 2.84
	02.9	×	
	04.8		
	06.8		
	08.8		
	10.8		
	12.8		
	14.8		
	L.		
14 07	17.9		
	19.9		
	21.9		
	23.9		
	25.9		
	27.9	×	
$14^h\ 07^m$	$29^s.9$		
	31.9		
	33.9		
	36.0		
	37.9		
	R.		
15 03	34.0		at $15^h\ 4^m$ upp. ther. 71.8
	36.0		low. " 69.8
	38.0		arc 1.50
	40.0		
	42.0		
	44.0		
	46.0	×	
	48.1		
	50.1		
	52.1		
	54.0		
	56.1		
	58.0		
	L.		
15 04	23.2		
	25.2		
	27.3		
	29.3		
	31.2		
	33.2		
	35.2	×	
	37.3		
	39.3		
	41.3		
	43.3		
	45.3		
	47.3		
	49.3		
	R.		
16 06	04.0		at $16^h\ 7^m$ arc 0.81
	06.2		at 16 9 upp. ther. 71°.7
	08.1		low. " 69.8
	10.2		bar. 20.924 inches
	12.2		at. ther. 74° F.
	14.1	×	
	16.2		
	18.2		
	20.2		
	22.2		
	24.2		
	L.		
$16^h\ 06^m$	$39^s.3$		
	41.3		
	43.3		
	45.3		
	47.4		
	49.4		
	51.4		
	53.4		
	55.4		
	57.4		
	59.4	×	
7	01.3		
	03.4		
	05.4		
	07.4		
	09.4		
	11.5		
	13.4		
	15.5		
	17.4		
	19.4		
	R.		
17[3] 09	16.3		at $17^h\ 8^m$ arc 0.48
	18.4		
	20.4		
	22.4		
	24.4		
	26.4	×	
	28.5		
	30.5		
	32.5		
	34.5		
	L.		
17[3] 09	51.5		
	53.5		
	55.5		
	57.5		
	59.5		
10	01.6		
	03.6		
	05.6	×	
	07.6		
	09.7		
	11 6		
	13.6		
	15.5		
	17.6		

[1] Some experiments made July 2d and 3d, with knife edges No. 3 and No. 1 facing the telescope and swinging, are here omitted. It was found, after reversing the pendulum end for end, that the wooden case interfered with the free action of the pendulum (in position, side No. 4 facing the telescope and swinging). The case was screwed closer to the wall, altering by 1° or 2° the inclination to horizontal plane of the faces on which the knife edges rest when pendulum is oscillating.

[2] Recorded 2°.10.

[3] Recorded 16^h

R.
17h 56m 34.0 at 17h 56m arc 0.33
36.1 at 17 59 upp. ther. 70°.8
38.1 low. " 68.7
40.1 bar. 29.901
42.2 at. ther. 73
44.2
46.1
48.1 ×
50.2
52.1
54.2
56.2
58.2
7 00.0

L.
17 57 09.3
11.2
13.2
15.2
17.2
19.2
21.2
23.2
25.2
27.2
29.2
31.2 ×
33.2
35.2
37.3
39.2
41.2
43.2
45.2
47.2
49.2
51.2 Stopped for the night.

July 3 (4th) 1860. Found pendulum still vibrating at 7 A. M.
Reversed to face No. 2.

R.
3 02 38.8 at 2h 50m upp. ther. 68°.6
40.8 " low. " 67.2
42.8 bar. 29.812
44.8 at. ther. 71
46.9 × at 3h 0m arc 3.82
48.9 observer, G. P. B.
50.9
52.9
54.8
56.8

L.
3 03 07.9
09.9
11.8
13.8
15.8
17.9
19.9
21.9 ×
23.9
25.9
27.9
29.9
31.9
33.9
35.9
38.0

R.
3 05 17.3
19.3
21.3
3h 05m 23.2
25.3
27.3 ×
29.3
31.2
33.3
35.3
37.3
39.3

L.
3 05 46.3
48.3
50.3
52.3
54.3
56.3 ×
58.3
06 00.3
02.3
04.3
06.4
08.3 at 3h 07m arc 3.16

R.
3 13 46.6
48.6
50.6
52.6
54.7
56.6
58.7
14 00.7 ×
02.6
04.7
06.7
08.7
10.7
12.7
14.7

L.
3 14 19.7
21.7
23.6
25.7
27.7
29.7
31.7
33.7
35.8
37.6 ×
39.8
41.7
43.7
45.7
47.7
49.8
51.7
53.7
55.7 at 3h 16m arc 3.09

R.
4 22 29.7 at 4h 20m upp. ther. 69°.2
31.7 " low. 67.5
33.7
35.7
37.7
39.7
41.7
43.6 ×
45.7
47.6
49.7
51.6
53.8
55.6

L.
4h 23m 10.7
12.6
14.6
16.6
18.6
20.6
22.6
24.7 ×
26.7
28.7
30.7
32.7
34.7
36.7
38.[illegible] at 4 25 arc 1.[illegible]

R.
4 26 28.2
30.3
32.3
34.3 ×
36.4
38.3

L.
4 26 45.3
47.3
49.3
51.3 ×
53.3
55.3

R.
5 38 57.7
59.7
39 01.7
03.6
05.6
07.6 ×
09.6
11.6
13.6
15.7
17.7

L.
5 39 22.8 at 5 40m arc 0.72
24.8
26.7
28.8
30.8
32.8 ×
34.8
36.8
38.8
40.8

R.
6 19 52.0
54.0
56.0
58.0
20 00.0
02.0 ×
04.1
06.0
08.1
10.1

L.
6 20 15.2
17.1
19.1
21.2
23.1
25.1 ×

6h 20m 27.2
29.1 at 6h 21m arc 0.50
31.1 upp. ther. 71.3
33.2 low. " 70.4

R.
7 07 59.6
08 01.5
03.6
05.6
07.6
09.6 ×
11.6
13.7
15.7
17.6
19.7

L.
7 08 24.7
26.7
28.7
30.7 at 7h 9m arc 0.33
32.7 upp. ther. 72.5
34.7 × low. " 72.0
36.8 at 7h 19m 40s.0 the vibration of pendulum was from left to right, the central transit occurring at the even second.
38.8
40.8
42.7
44.8
Reversed to No. 1.

R.
7 24 48.1 Pendulum was reversed at about 7h 10m; face No. 1 swinging and towards the telescope.
50.1
52.1
54.1
56.1
58.1
25 00.2 × observer, G. P. B.
02.1
04.1
06.1
08.1
10.2
12.2

L.
7 25 17.1 at 7h 25m arc 4.45
19.1
21.0
23.2
25.1 ×
27.2
29.2
31.1
33.2
35.2

R.
7 27 24.6
26.5
28.5 ×
30.5
32.5
35.5[1]
37.6
39.6
41.6
43.5 ×
45.6
47.6
49.6
51.5

R.
7 30 31.0 at 7h 29m arc 4.30
33.0
35.0

7h 30m 37.0
39.0 ×
41.0
43.1
45.0
47.0

L.
7 30 50.0 at 7h 30m arc 4.17
52.0
54.0
56.1
58.0 ×
31 00.0
02.1
04.0
06.0
08.1

R.
7 38 32.3 at 7h 38m arc 3.62
34.3 ×
36.3

L.
7 38 41.3 at 7h 39m upp. ther. 73.3
43.4 × low. " 72.9
45.4

R.
12 14 35.9 at 12h 08m arc 0.26
38.0 at 12 14 upp. ther. 73.2
40.0 " low. " 72.3
42.0
44.0
46.1
48.0
50.0 ×
52.0
54.0
56.1
58.0
15 00.0
02.0
04.0

L.
12 15 13.0
14.9
17.0
19.0
21.0
22.9
25.0
27.0
29.0 ×
31.0
33.0
35.0
37.1
39.0
41.0
43.0

R.
12 17 48.5
50.5
52.5
54.5 ×
56.5
58.6
18 00.5

L.
12 18 07.4
09.4
11.4
13.4

12 18 15.5
17.6 ×
19.6
21.7
23.6
25.6
27.5

R.
12 22 27.1
29.2
31.2 ×
33.2
35.2

L.
12 22 42.1
44.2
46.2
48.2
50.3 ×
- - - at 12h 24m upp. ther. 72°.8
54.2 " low. " 71.9
56.2 bar. 29.790
58.2 at. ther. 74
Reversed to face No. 3, swinging and towards the telescope.

R (?)[2] observer, G. P. B.
12 56 21.0
23.0
25.0 ×
27.0
29.0
31.1

L (?)[2]
12 56 38.0
40.0
42.1 ×
44.0
46.1
48.0

R.
16 19 48.7 at 16h 15m upp. ther. 70°.2
50.7 " low. " 69.0
52.7 × arc 0.43
54.7
56.7
58.7

L.
16 20 03.6
05.6
07.6 ×
09.6
11.6

R.
17 18 21.6 at 17h 18m arc 0.25
23.7
25.6 ×
27.6
29.6

L.
17 18 32.7 upp. ther. 70°.0
34.7 low. " 68.9
36.7 × bar. 29.830
38.7 at. ther. 71.
40.7

N. B. The last sets of observations, face Nos. 1 and 3, were taken without any alterations of the case from its position for Nos. 2 and 4.

[1] Should be L.

[2] As assumed by Mr. Sonntag; left blank in MS. To judge from the rate of the clock it should be L. and R. [Sch.]

FORMULÆ AND METHOD OF REDUCTION.

To render the results obtained at different places comparable with each other, the observed number of vibrations require the following corrections, that for rate of clock having first been applied.

Reduction to Infinitely Small Arc.

The duration of a vibration in any small arc is always greater than in an infinitely small arc, the correction to the observed number of vibrations is therefore additive.

Let A = the initial semi-arc of vibration

a = the terminal semi-arc of vibration

N = number of vibrations in a given time;

then the correction $= N \dfrac{M\, sin\,(A+a)\; sin\,(A-a)}{32\,(\log.\, sin\, A - \log.\, sin\, a)} = N \dfrac{M\, sin^2\, 1^\circ}{32} \cdot \dfrac{A^2-a^2}{\log.\, A - \log.\, a}$

At Cambridge the number, N, of vibrations in a mean solar day is about 86420, at Port Foulke about 86550, and since M, the logarithmic modulus = 0.4342945, the logarithm of the factor $N \cdot \dfrac{M\, sin^2\, 1^\circ}{32}$ becomes [9.55295] and [9.55361] respectively for these localities.

Correction for Temperature of Pendulum.

For a higher temperature than the adopted standard temperature, the pendulum becomes longer, and the number of vibrations are diminished; the correction to N is therefore positive, for a lower temperature than the standard temperature, the correction is negative.

Let e = coefficient of expansion of the material of the pendulum bar

t = observed temperature

t_0 = standard temperature

then the correction $= N \dfrac{e}{2}(t-t_0)$

The average temperature of the pendulum, when swung at Cambridge, was about 71°, and at Port Foulke about 23° Fah. I have therefore adopted 50° Fah. as a convenient standard temperature.

Reliable determinations of e for 1° Fah. seem to vary between 0.0000104 and 0.0000105, taking the mean and using N as above we find for the coefficient of $t-t_0$ the value 0.4511 for Cambridge, and 0.4518 for Port Foulke, or the logarithmic factors [9.65428] and [9.65494] respectively

Correction for Buoyancy.

As the pendulum was not swung in a rarified medium to ascertain the correction for buoyancy and resistance experimentally, we use the coefficient determined by Bailey (see Vol. VII, p. 27, Memoirs Royal Astronomical Society).

Let β = reading of barometer in inches, and reduced to 32° Fah.

t = temperature of the air in degrees of Fah.; then the correction to the number of vibrations made in a mean solar day by a brass pendulum

$$=0.3541 \frac{\beta}{1+0.0023\,(t-32)}$$

The average reading of the barometer (reduced to 32°) at Cambridge is $29^{in}.72$, and at Port Foulke $29^{in}.82$, the observations have therefore been referred to the convenient average reading $29^{in}.8$ by the formula

$$\frac{0.3541\,(\beta-\beta_0)}{1+0.0023\,(t-32)}$$

The average t at Cambridge is 70°.9, and at Port Foulke + 22°.8 hence the correction for Cambridge $0.325\,(\beta-29.8)$, and for Port Foulke $0.362\,(\beta-29.8)$. The reduction to vacuum is always additive. The variations from the average t at either place are small.

Reduction to the Level of the Sea.

Let N = number of vibrations at the elevated station

N_1 = corresponding number at the sea level

H = the elevation and R = the earth's radius, then the reduction to the number of vibrations in a day (see Vol. VII, p. 28, Mem. Roy. Ast. Soc.) $=0.666\,N\frac{H}{R}$ a correction which is always additive. For Cambridge we have $0.00276\,H$, and for Port Foulke $0.00277\,H$, the elevation, above half tide being expressed in feet.

From the preceding record the following abstract of observed times, arcs, temperatures and atmospheric pressure has been formed.

The first column contains the number of observed times united into a mean; the second column the average clock times of vibrations from right to left; for an odd number of times the mean corresponding to the middle one is set down; for an even number either the first or last observation was omitted; the middle times, in all cases are marked thus × in the preceding record; the third column contains the arcs of vibration; when not directly observed they were interpolated by a graphical process, the arcs are inversely as the squares of the times, and the curves constructed on a sufficiently large scale proved them to be quite smooth and regular; the fourth column contains the average temperatures observed or interpolated. The next column contains similar information for vibrations from left to right, and the last column gives the observed height of the barometer when referred to temperature 32° Fah.

The first means for face 3 have been corrected by subtracting one second to refer to "right" and "left" respectively.

Reduction of Pendulum Experiments made in July, 1860, at Cambridge, Mass

Ob's.	Clock times, R.	Arc.	Temp.	Ob's.	Clock times, L.	Arc.	Bar.
			Face 4.				
9	13h 57m 23s.21	3°.15	71.3	11	13h 57m 48s.25	3°.15	
11	14 07 02.81	2.84	71.2	11	14 07 27.91	2.84	
13	15 03 46.03	1.50	70.8	13	15 04 35.26	1.50	
11	16 06 14.16	0.81	70.7	21	16 06 59.38	0.81	29.80
9	17 09 26.43	0.48	70.1	13	17 10 05.57	0.48	
13	17 56 48.14	0.33	69.7	21	17 57 31.20	0.33	29.78
			Face 2.				
9	3 02 46.84	3.70	67.9	15	3 03 21.88	3.65	29.70
11	3 05 27.28	3.53	68.0	11	3 05 56.31	3.50	
15	3 14 00.66	3.15	68.2	19	3 14 37.71	3.15	
13	4 22 43.68	- - -	68.3	15	4 23 21.65	- - -	
5	4 26 34.32	- - -	- - -	5	4 26 51.30	- - -	
11	5 39 07.65	0.72	70.0	9	5 39 32.79	0.72	
9	6 20 02.03	0.50	70.8	9	6 20 25.13	0.50	
11	7 08 09.62	0.33	72.2	11	7 08 34.74	0.33	
			Face 1.				
13	7 25 00.12	4.45	72.7	9	7 25 25.13	4.45	
5	7 27 28.52	4.30	72.8	9	7 27 43.57	4.30	
9	7 30 39.01	4.17	72.9	9	7 30 58.02	4.17	
3	7 38 34.30	- - -	73.1	3	7 38 43.37	- - -	
15	12 14 50.00	0.25	72.7	15	12 15 28.99	0.25	
7	12 17 54.51	0.23	72.9	11	12 18 17.52	0.23	
5	12 22 31.18	0.20	72.3	9	12 22 50.21	0.20	29.67
			Face 3.				
5	12 56 25.00	3.40	72.0	5	12 56 42.04	3.40	
	— 1.00				— 1.00		
5	16 19 52.70	0.40	69.6	5	16 20 07.60	0.40	
5	16 18 25.62	0.25	69.4	5	17 18 36.70	0.25	29.72

The following reduction gives, in the first place, the intervals of the clock times obtained, for face 4, by subtracting the first mean from the fourth, the second from the fifth, and the third from the sixth; for face 2 by omitting the means at 4 hours as they will contribute almost nothing to the accuracy of the result, and then proceeding as in the preceding case for face 4; for face 1 by the same treatment after omitting the central mean, and for face 3 by subtracting the first from the second and third means.

These clock intervals are next reduced to mean time intervals by application of a correction for rate (r). It was found convenient to apply this correction separately for rate of clock on sidereal time, for which purpose a small table was computed extending to 5 hours, and secondly for acceleration of sidereal on mean time.

The mean time intervals, expressed in seconds, are followed by the corresponding number of vibrations performed in the intervals from which, by proportion, the number of vibrations N performed in a day are computed. The corrections for arc, temperature, and atmospheric pressure were computed by the formulæ given above.

Clock intervals.	Correction for rate.	Mean time intervals.	Number of vibr's.	Corres. No. in a day.	Corrections for Arc.	Corrections for Temp.	Corrections for Atm. pr.	N
			Face	4.				
Vibr's right								
$2^h\ 08^m\ 50^s.95$	—21.^{s}37	7709^s.58	7710	86404 71	+1.39	+9.47	.00	86415.57
3 02 23.62	—30.23	10913.39	10914	86404.80	+0.91	+9 29	"	15.00
2 53 02.11	—28.68	10353.43	10354	86404.74	+0.30	+9.11	"	14.15
Vibr's left								
2 09 11.13	—21.42	7729.71	7730	86403.24	+1.39	+9.47	"	86414.10
3 02 37.66	—38.28	10927.38	10928	86405.92	+0.91	+9.29	"	16.12
2 52 55.94	—28.67	10347.27	10348	86406.10	+0.30	+9.11	"	15.51
							Mean	86415.67
			Face	2.				
Vibr's right								
2 36 20.81	—25.92	9354 89	9356	86410.26	+1.66	+8.57	—.03	86420.46
3 14 34.75	—32.26	11642.49	11644	86411.20	+1.29	+8.75	"	21.21
3 54 08.96	—38.83	14010.13	14012	86411.54	+0.91	+9.11	"	21.53
Vibr's left								
2 36 10.91	—25.89	9345.02	9346	86410.68	+1.62	+8.57	—.03	86420 84
3 14 28.82	—32.25	11636.57	11638	86410.62	+1.27	+8.75	"	20.61
3 53 57.03	—38.80	13998.23	14000	86411.83	+0.91	+9.11	"	21.82
							Mean	86421.08
			Face	1.				
Vibr's right								
4 49 49.88	—48.06	17341.82	17344	86410.86	+1.42	+10.24	—.04	86422.48
4 50 25.99	—48.16	17377.83	17380	86410.78	+1.31	+10.28	"	22.33
4 51 52.17	—48.39	17463.78	17466	86410.98	+1.17	+10.19	"	22.30
Vibr's left								
4 50 03.86	—48.10	17355.76	17358	86411.16	+1.42	+10.24	"	86422.78
4 50 33.95	—48.18	17385.77	17388	86411.06	+1.31	+10.28	"	22.61
4 51 52.19	—48.39	17463.80	17466	86410.90	+1.17	+10.19	"	22.22
							Mean	86422.45
			Face	3.				
Vibr's right								
3 23 28.70	—33.74	12174.96	12176	86407.38	+1.10	+9.38	—.04	86417.82
4 22 01.62	—43.44	15678.18	15680	86410.02	+0.68	+9 34	"	20.00
Vibr's left								
3 23 26.56	—33.74	12172.82	12174	86408 36	+1.10	+9.38	"	86418.80
4 21 55.66	—43.42	15672.24	15674	86409.68	+0.68	+9.34	"	19.66
								86419.07

We have therefore the following resulting number of vibrations performed at Cambridge in a mean solar day, the temperature of the pendulum being 50° Fah., and the atmospheric pressure 29.8 inches (with the mercury at the temperature of freezing water).

First position of pendulum.	After reversal, end for end.
Face 4 swinging, 86415.07	Face 1 swinging, 86422.45
" 2 " 86421.08	" 3 " 86419.07
Mean, 86418.08	Mean, 86420.76

Mean of two positions 86419.42
Correction for 80[1] feet elevation above half tide + ...22

Resulting number of vibrations at the level of the sea in the latitude of Cambridge 86419.64

The Cambridge Observatory is in latitude 42° 22′ 51″.5

Observations connected with Pendulum Experiments at Port Foulke.

The following observations for local time at Port Foulke were taken for the special purpose of furnishing the chronometer rate required for the pendulum experiments. The observed double altitudes of α Lyræ, September 22d and October 17th, 1860, given in the preceding part of the astronomical record, belong to the same series.

Observations for time, October 1, 1860.

Double altitudes of α Lyræ, with reflecting circle. A. Sonntag, observer.

Index $\begin{Bmatrix} +1' \ 20'' & +1' \ 30'' & +1' \ 20'' \\ +1 \ \ 00 & +1 \ \ 10 & +1 \ \ 50 \end{Bmatrix}$ Correction + 1′ 11″.7

Pocket chronometer	2*	Pocket chronometer	2*
10h 34m 08s	87° 53′ {40″, 30}	10h 44m 03s	86° 56′ {40″, 40}
35 20	46 {40, 10}	44 57	51 {20, 00}
36 09	41 {30, 20}	46 04	44 {60, 40}
37 08	35 {30, 20}	47 18	37 {60, 30}
38 08	30 {40, 10}	48 09	32 {80, 50}
38 57	24 {50, 40}	49 02	26 {50, 40}
39 57	20 {50, 30}	49 44	23 {40, 40}
40 55	15 {20, 10}	50 28	19 {40, 30}
42 13	08 {20, 10}	51 55	11 {60, 30}
43 08	01 {60, 50}	52 49	05 {40, 40}

T = + 16°.5, B = 29in.693 at 20° Index $\begin{Bmatrix} +1' \ 10'' & +1' \ 20'' & +1' \ 20'' \\ +1 \ \ 00 & +1 \ \ 00 & +1 \ \ 00 \end{Bmatrix}$ Corr'n + 1′ 08″.3

(As in preceding cases, the observations were combined two by two.)

Refr'n for first pair — 1′ 04″.7, for last —1′ 06″.6
*'s declination δ = + 38° 39′ 35″.4, right ascension α = 18h 32m 13s.9

Sidereal time at mean noon 12h 42m 33s.6; the sidereal time is converted into mean time, and ΔT is the chronometer correction on mean local time.

[1] Annals of the Observatory, Vol. I, Part I, p. xvi.

T	h	t	ΔT
10h 34m 44s	43° 54′ 30″	58° 54′ 40″	—51m 01s
10 36 38.5	43 48 43	59 25 25	—50 53
10 38 32.5	43 43 17	59 54 03	—50 53
10 40 26	43 38 28	60 19 23	—51 05
10 42 40.5	43 32 02	60 53 11	—51 05
10 44 30	43 26 27	61 22 25	—50 57
10 46 41	43 20 08	61 55 19	—50 57
10 48 35.5	43 14 26	62 24 54	—50 54
10 50 06	43 10 17	62 46 25	—50 58
10 52 22	43 03 50	63 19 46	—51 01
		Mean . .	—50 58.4 ± 0s.9

Observations for time, October 2, 1860.

Double altitudes of α Lyræ, with reflecting circle. A. Sonntag, observer

Index $\begin{Bmatrix} +0' & 40'' & +0' & 40'' & +1' & 10'' \\ +0 & 40 & +0 & 30 & +1 & 10 \end{Bmatrix}$ Correction + 0′ 48″.3

Pocket chronometer	2✱	Pocket chronometer	2✱
10h 46m 59s	86° 04′ {20″ / 30}	11h 20m 45s	82° 43′ {60″ / 50}
48 37	85 54 {60 / 50}	21 41	38 {20 / 00}
50 19	45 {00 / 20}	22 35	32 {40 / 20}
51 31	38 {30 / 20}	23 49	25 {10 / 00}
53 32	25 {30 / 20}	24 37	20 {10 / 00}
54 32	19 {60 / 50}	25 23	15 {40 / 10}
55 35	14 {20 / 20}	26 14	09 {30 / 20}
56 25	09 {30 / 20}	27 35	02 {10 / 10}
57 45	00 {50 / 40}	28 24	81 57 {20 / 10}
58 35	84 55 {70 / 40}	29 46	48 {40 / 30}
11 00 10	47 {20 / 20}	30 38	42 {30 / 10}
01 07	40 {50 / 50}	31 55	35 {30 / 10}
02 10	34 {80 / 50}	32 56	28 {30 / 20}
03 01	29 {30 / 20}	33 39	23 {30 / 40}
03 49	24 {80 / 50}	35 00	17 {60 / 40}
05 06	15 {80 / 40}	35 55	11 {10 / 00}

Index $\begin{Bmatrix} +1' & 20'' & +1' & 30'' & +1' & 20'' \\ +1 & 10 & +1 & 20 & +1 & 00 \end{Bmatrix}$ Correction + 1′ 16″.6

T = + 13°.6, B = 29in.841 at 27° Index $\begin{Bmatrix} +1' & 10'' & +1' & 30'' & +1' & 00'' \\ +1 & 10 & +1 & 30 & +1 & 10 \end{Bmatrix}$ Corr'n = + 1′ 15″

$r = -1'\ 07''.5$ $r_1 = -1'\ 13''.3$

$\delta = +38°\ 39'\ 35''.4$ $\alpha = 18^h\ 32^m\ 13^s.9$

Sidereal time at mean noon, 12 46 30.2

T	h	z	ΔT
$10^h\ 47^m\ 48^s$	$42^\circ\ 59'\ 14''$	$63^\circ\ 43'\ 30''$	$-48^m\ 49^s$
10 50 55	42 50 17	64 29 27	52
10 54 02	42 40 43	65 18 26	44
10 56 00	42 35 19	65 45 57	52
10 58 10	42 28 32	66 20 30	44
11 00 43.5	42 21 24	66 56 42	44
11 02 35.5	42 15 29	67 26 42	46
11 04 27.5	42 09 37	67 56 18	40
11 21 13	41 19 58	72 05 09	53
11 23 12	41 13 58	72 35 39	50
11 25 00	41 08 19	73 03 09	48
11 26 54.5	41 02 20	73 32 53	44
11 29 05.5	40 55 53	74 04 50	48
11 31 16.5	40 48 50	74 39 49	39
11 33 17.5	40 42 25	75 11 34	33 rejected
11 35 27.5	40 36 38	75 40 10	49
		Mean	$-48\ \ 46.8 \pm 0^s.7$

Observations for time, October 9, 1860.

Double altitudes of α Lyræ, with reflecting circle. A. Sonntag, observer.

Index $\left\{\begin{matrix} +1'\ 20'' & +1'\ 00'' & +1'\ 10'' \\ +1\ \ 10 & +0\ \ 50 & +0\ \ 50 \end{matrix}\right\}$ Correction $+1'\ 3''.3$

Pocket chronometer	2*		Pocket chronometer	2*	
$10^h\ 33^m\ 42^s$	$84^\circ\ 40'$	20″, 30	$10^h\ 50^m\ 08^s$	$83^\circ\ 02'$	20″, 20
34 32	36	20, 20	50 51	82 57	20, 20
35 29	30	40, 40	51 43	53	20, 30
36 17	25	40, 30	52 35	48	10, 10
37 10	20	40, 40	53 31	43	20, 00
38 17	14	40, 30	54 26	36	30, 00
39 37	5	50, 50	55 45	28	40, 20
40 40	83 59	20, 30	56 37	23	10, 20
41 46	52	40, 20	57 22	18	40, 50
42 52	47	00, 00	58 12	13	40, 20
43 47	40	40, 40	59 13	7	30, 40
45 18	30	40, 40	11 00 02	2	20, 30
46 01	26	20, 40	0 55	81 57	10, 00
46 52	22	20, 30	1 43	52	30, 10
47 53	15	60, 40	2 43	45	20, 40
48 42	10	50, 50	3 36	41	20, 20

Roof of artificial horizon reversed.

$T = +19^\circ.5$, $B = 30^{in}.072$ at 30° Index $\left\{\begin{matrix} +2'\ 10'' & +1'\ 50'' & +1'\ 40'' & +1'\ 40'' \\ +2\ \ 20 & +1\ \ 50 & +1\ \ 50 & +1'\ 40 \end{matrix}\right\}$ Corr'n $+1'\ 52''.5$

$r = -1'\ 08''.7$ $\quad r_1 = -1'\ 12''.3$

$\delta = +38^\circ\ 39'\ 35''.3$ $\quad \alpha = 18^h\ 32^m\ 13^s.7$

Sidereal time at mean noon, 13 14 06.1

T	h	t	ΔT
10^h 34^m 07^s	42° 18′ 46″	67° 10′ 00″	-48^m 56^s
35 53	42 13 39	67 35 57	58
37 43.5	42 08 21	68 02 29	63
40 08.5	42 00 53	68 40 18	57
42 19	41 54 29	69 12 28	59
44 32.5	41 47 24	69 48 04	50
46 26.5	41 41 48	70 16 10	52
48 17.5	41 36 14	70 44 01	52
50 31	41 29 28	71 17 46	51
52 09	41 24 57	71 40 21	59
53 58.5	41 19 24	72 07 58	58
56 11	41 12 29	72 42 24	53
57 47	41 07 36	73 06 42	53
59 37.5	41 02 02	73 34 09	54
11 01 19	40 56 53	73 59 53	52
03 09.5	40 51 14	74 27 53	51
		Mean . . .	−48 54.9 ± 0ˢ.6

Observations for time, October 10, 1860.

Double altitudes of α Lyræ, with reflecting circle. A. Sonntag, observer.

Index $\begin{cases} +1' \, 40'' & +1' \, 20'' & +0' \, 40'' \\ +1 \;\; 30 & +1 \;\; 00 & +0 \;\; 40 \end{cases}$ Correction = + 1′ 08″.3

Pocket chronometer	2*	Pocket chronometer	2*
10^h 54^m 47^s	82° 11′ {20″ 00	11^h 05^m 38^s	81° 03′ {40″ 40
56 01	4 {20 00	7 15	80 54 {20 20
58 55	81 45 {40 20	8 16	48 {00 00
59 52	39 {60 40	9 51	39 {20 10
11 00 43	33 {60 50	10 54	33 {30 10
1 16	29 {10 10	11 45	27 {20 20
3 14	19 {40 50	12 41	21 {20 30
4 19	12 {60 40	13 35	16 {20 00

T = + 12°.5, Bar. $30^{in}.050$ at 25° Index $\begin{cases} +1' \, 30'' & +1' \, 20'' & +0' \, 50'' \\ +1 \;\; 20 & +1 \;\; 20 & +0 \;\; 40 \end{cases}$ Correction + 1′ 10″

$r = -1' \, 12''.9$ $r_1 = -1' \, 15''.3$

$\delta = +38° \, 39' \, 35''.2$ $\alpha = 18^h \, 32^m \, 13^s.7$

Sidereal time at mean noon, 13 18 02.6

T	h	t	ΔT
10^h 55^m 24^s	41° 03′ 12″	73° 28′ 34″	-48^m 58^s
59 23.5	40 50 41	74 30 37	50
11 01 14.5	40 45 07	74 58 11	51
03 46.5	40 37 29	75 35 58	53
06 26.5	40 28 50	76 18 44	42
09 03.5	40 21 09	76 56 43	48
11 19.5	40 14 30	77 29 33	52
13 08	40 08 43	77 58 03	47
		Mean . . .	−48 50.1 ± 1ˢ.1

RECAPITULATION OF OBSERVED CORRECTION OF POCKET CHRONOMETER AT PORT FOULKE, IN CONNECTION WITH PENDULUM EXPERIMENTS.

	T				ΔT on mean time.
1860.	September	22 at	11^h	chronometer time	$-50^m\ 43^s.3 \pm 0^s.9$
1860.	October	1	11	" "	$-50\ \ 58.4 \quad 0.9$
1860.	October	2	11	" "	$-48\ \ 46.8 \quad 0.7$
1860.	October	9	11	" "	$-48\ \ 54.9 \quad 0.6$
1860.	October	10	11	" "	$-48\ \ 50.1 \quad 1.1$
1860.	October	17	10	" "	$-48\ \ 58.5 \quad 0.7$

The chronometer changed its correction about $2^m.2$ between 9 A. M. and 3 P. M., October 2d; retarded or stopped in consequence of a hair having become entangled in one of the hands.

The actual rate of the pocket chronometer, during the pendulum experiments, is found by means of comparisons of the pocket chronometer with three mean time chronometers; comparisons were made at the beginning and end of each daily set of pendulum experiments.

Chronometer comparisons for correction and rate of mean time chronometers 2007, 1062, and 740. (Those for September 22d have already been given.)

October 1, 1860.

Pocket chronometer.	Mean time.	Chronometers.	ΔT at Port Foulke.
$11^h\ 25^m\ 24^s.0$	$10^h\ 34^m\ 25^s.6$	2007 : $3^h\ 26^m$	$-4^h\ 51^m\ 34^s.4$
26 54.0	10 35 55.6	1062 : 3 25	−4 49 04.4
28 31.2	10 37 32.8	740 : 3 27	−4 49 27.2

October 2, 1860.

Pocket chronometer.	Mean time.	Chronometers.	ΔT	
$11^h\ 02^m\ 15^s.3$	$10^h\ 13^m\ 28^s.5$	2007 : $3^h\ 05^m$	$-4^h\ 51^m\ 31^s.5$	Two sets of comparisons were taken, according within a fraction of a second. The value given is the mean.
2 43.5	10 13 56.7	1062 : 3 03	−4 49 03.3	
4 21.0	10 15 34.2	740 : 3 05	−4 49 25.8	

October 9, 1860.

Pocket chronometer.	Mean time.	Chronometers.	ΔT	
$10^h\ 39^m\ 02^s.0$	$9^h\ 50^m\ 07^s.1$	2007 : $2^h\ 41^m$	$-4^h\ 50^m\ 52^s.9$	Two sets of comparisons were taken; they do not differ by more than $0^s.2$.
39 41.9	9 50 47.0	1062 : 2 40	−4 49 13.0	
41 21.9	9 52 27.0	740 : 2 42	−4 49 33.0	

October 10, 1860.

Pocket chronometer.	Mean time.	Chronometers.	ΔT	
$10^h\ 52^m\ 04^s.0$	$10^h\ 03^m\ 13^s.9$	2007 : $2^h\ 54^m$	$-4^h\ 50^m\ 46^s.1$	Two sets were taken; greatest difference $0^s.4$; the mean is here given.
52 42.2	10 03 52.1	1062 : 2 53	−4 49 07.9	
53 22.5	10 04 32.4	740 : 2 54	−4 49 27.6	

October 17, 1860.

Pocket chronometer.	Mean time.	Chronometers.	ΔT	
$10^h\ 05^m\ 23^s.0$	$9^h\ 16^m\ 24^s.5$	2007 : $2^h\ 7^m$	$-4^h\ 50^m\ 35^s.5$	Mean of two sets; values do not differ by more than a fraction of a second.
06 51.4	9 17 52.9	1062 : 2 7	−4 49 07.1	
07 32.1	9 18 33.6	740 : 2 8	−4 49 26.4	

October 31, 1860. ΔT Pocket chronometer $-49^m\ 15^s.2 \pm 0^s.7$.

Pocket chronometer.	Mean time.	Chronometers.	ΔT
$9^h\ 24^m\ 50^s.0$	$8^h\ 35^m\ 34^s.8$	2007 : $1^h\ 26^m$	$-4^h\ 50^m\ 25^s.2$
25 53.6	8 36 38.4	1062 : 1 26	−4 49 21.6
26 39.0	8 37 23.8	740 : 1 27	−4 49 36.2

If we combine the values of ΔT for October 1 and October 2, viz: $-4^h\ 51^m\ 33^s.0$, $-4^h\ 49^m\ 03^s.8$, $-4^h\ 49^m\ 26^s.5$ respectively, also the values for October 9 and October 10, viz: $-4^h\ 50^m\ 49^s.5$, $-4^h\ 49^m\ 10^s.5$, $-4^h\ 49^m\ 30^s.3$ respectively, we deduce the following table of daily rates:—

Daily rate of mean time chronometers.

	2007	1062	740
1860. September 22, 17^h chronometer time	$+2^s.64$	$+0^s.88$	$+0^s.86$
1860. October 2, 3 " "	+5.44	—0.84	—0.47
1860. October 10, 3 " "	+1.88	+0.45	+0.52
1860. October 17, 14 " "	+0.74	—1.09	—0.70
1860. October 31, 13 " "			

PENDULUM EXPERIMENTS AT PORT FOULKE.

Explanatory Remarks and Record of Observations.

The pendulum was swung at the Port Foulke Observatory on the same knife edges as at Cambridge, the experiments extending over fourteen days between September 26th and October 12th, 1860. These observations were made by Mr. August Sonntag, assisted by Mr. H. Radcliff. The initial letters of the observer's name are attached to each set of experiments. The following information is taken from notes made by Mr. Sonntag. "From a preliminary set of observations on the morning of September 26th, it was found that at a temperature of 22° Fah. the pendulum made very nearly 3607 vibrations in 3600 seconds of the pocket chronometer.

The time was noted when the swinging knife-edge passed the zero of the graduated arc. The pendulum being at rest, this zero appeared 0°.05 to the right (in an inverting telescope) of the point of the knife-edge, producing a small difference in the intervals when the pendulum was swinging from left to right and when swinging in the opposite direction; the mean of the intervals, however, is not affected thereby.

The observations were always commenced with a set marked 'Left,' the pendulum when seen through the inverting telescope appearing to swing from left to right; immediately after a set is taken with the pendulum appearing in the opposite direction marked 'Right.' Each set consists generally of eleven observations at intervals of ten seconds, the mean is given at the bottom. The times are recorded by means of the pocket chronometer. The semi-arcs are recorded, counted from the middle either way. The azimuth of the plane of vibration was nearly N. W. and S. E."

The following description of the Observatory was received from Dr. Hayes: The Port Foulke Observatory was a small frame structure, eight feet square, by seven feet high in the centre, the roof pitching only one way. It was covered on the outside with canvas, and was lined internally with bear, seal, and other skins. To give greater warmth and solidity the snow was, during the winter, banked up around it, covering it almost completely. It was erected on the first of a series of terraces which lay northeast from the anchorage, and its foundation was thirty-eight feet above the mean tidal level. The rock on which it stood was primitive (a dark reddish-brown syenite), which rose on either side of the harbor into hills from six

to eight hundred feet high. It faced to the southwest, its axis being nearly in the magnetic meridian.

The pendulum apparatus was erected in the autumn. The foot of the box containing it rested upon the solid rock, and the instrument stood in the S. E. (mag.) corner, facing N. W. (mag.).

Experiments, set 1, face 1. September 26th P. M. 1860. Observer, A. Sonntag.

L.	R.	L.	R.	
$2^h\ 48^m\ 29^s.5$	$2^h\ 50^m\ 46^s$	$2^h\ 53^m\ 09^s$	$2^h\ 55^m\ 29^s.8$	at $2^h\ 48^m$ arc $\{1^\circ.85$
39.0	56	19	39.5	$\{1.78$
49.5	06.3	29	49.5	temp. $\{27^\circ.5$ Fah.
59.8	16.5	38.8	00	$\{24.5$
09.5	26	48.8	10	bar. $29^{in}.720$ at $29^\circ.5$
19.5	36	58.8	19.8	
[illegible]9.5	46	09	29.5	
39	56	18.8	39.5	
49	06	28.5	49.5	
59.5	16	38.5	00	at $2^h\ 58^m$ arc $\{1^\circ.58$
2 50 09.5	2 52 26	2 54 48.5	2 57 10	$\{1.50$
2 49 19.39	2 51 36.07	2 53 58.79	2 56 19.74	
2 59 20.4	2 01 23	3 07 31.5	3 09 [illegible]	
30.5	33	41.5	42	
40.3	43	51	52	
50.3	53.2	01.3	02	
00.3	03.2	11.5	12.3	
H. R. 10.2	H. R. 13.2	A. S. 21.2	A. S. 22	
20.4	23	31	32	
30.5	33.1	41	42	
40.3	43	51	52	
50.2	53	01	02	
3 1 00.3	3 03 03.2	3 09 11	3 11 12	
3 00 10.34	3 02 13.08	3 08 21.18	3 10 22.03	
6 40 29	6 42 35.5	6 53 19	[1]6 55 14	at $6^h\ 40^m$ arc $\{0^\circ.18$
38.8	45.5	29.3	24	$\{0.12$
48.5	55.3	39	33.8	
58.5	05.3	49	43.5	
09	15.3	59	54	
A. S. 19	A. S. 25	A. S. 09.5	A. S. 04	
28.8	35	19	14	
38.5	45	29	23.5	
48.3	55	39	34	at $6^h\ 57^m$ arc $\{0.17$
58.5	05	6 54 48.8	6 56 43.5	$\{0.10$ temp. $\{23.3$
6 42 09	6 44 15			$\{22.0$
6 41 18.72	6 43 25.17	5 54 09.06	6 56 03.83	bar. $29^{in}.810$ at 32.8
6 59 03.0	7 01 05.7	[1] Omitted in mean.		Chronometer comparisons
13.0	15.6			A. M. No.
22.9	25.3		Pock. Chron'r	$9^h\ 41^m\ 59^s.0 = 1^h\ 43^m$ by 2007
32.7	35.2		Deduced hourly rate = —$0^s.30$ (between 3^h and 6^h).	42 39.8 1 41 1062
42.5	45			43 16.3 1 42 740
H. R. 52.6	H. R. 55.2			P. M.
02.8	05.3			3 21 00.2 7 22 2007
12.8	15.2			21 40.7 7 20 1062
22.7	25.2			22 17.2 7 21 740
32.3	35			6 03 1.0 10 4 2007
7 00 42.2	7 02 45			4 42.2 10 3 1062
6 .9 52.68	7 01 55.25			5 17.8 10 4 740

Set 2, face 1.

L.		R.		L.		R.		
7 2[illegible]		[illegible] 28	23	7 30	55.5	7 33	02.5	at $7^h 25^m$ arc $\begin{cases}1^\circ.52\\1.42\end{cases}$
			33		05.5		12.5	
	[illegible]		43		15.5		22.3	temp. $\begin{cases}24.3\\23.0\end{cases}$
	46				26		32.5	
	56		03.2		36		42.3	bar. $29^{in}.810$ at $32^\circ.0$
A. S.	06.2	A. S.	13	A. S.	45.5	A. S.	52	
	16		23		55.5		02.5	
	26		33		05.8		12.5	
	36		42.		15.8		22	
	46		52.5		25.3		32	
7 27	56	7 30	03	7 32	35.5	7 34	42.3	at $7^h 35^m$ arc $\begin{cases}1^\circ.30\\1.22\end{cases}$
7 27	06.05	7 29	12.95	7 31	45.63	7 33	52.31	
7 36	51	7 38	54	7 43	08.5	7 45	15	
	01.2		04.2		18.5		25	
	11.2		14		28		35	
	21.2		23.7		38		45	
	31		33.7		48.3		55	
H. R.	41	H. R.	43.8	A. S.	58.3	A. S.	05.3	
	51		54.0		08.2		15	
	01.2		04		18.5		24.8	
	11.2		14		28		34.8	at $7^h 48^m$ arc $\begin{cases}1^\circ.10\\1.03\end{cases}$
	21		23.6		38		44.8	temp. $\begin{cases}28^\circ.0\\25.0\end{cases}$?
7 38	31	7 40	33.4	7 44	48	7 46	55	
7 37	41.09	7 39	43.86	7 43	58.21	7 46	04.97	
10 46	05	10 48	11.8	10 50	26	10 52	20.5	at $10^h 45^m$ arc $\begin{cases}0^\circ.19\\0.13\end{cases}$
	15		21.5		36		30.8	
	25		31.5		46		41	
	34.8		41		56		51	
	44.8		51.3		06		01	
A. S.	55	A. S.	01.5	A. S.	16.3	A. S.	11.3	
	05		11.5		26		21	
	15		21.5		36		30.8	
	24.5		31		46.3		40.8	
	34.5		41		56		50.8	at $10^h 54^m$ arc $\begin{cases}0^\circ.19\\0.13\end{cases}$
10 47	44.8		51.3	10 52	06	10 54	01	
10 46	54.85	10 49	01.35	10 51	16.05	10 53	10.91	
10 55	16	10 57	10.8					Chronometer comparisons
	26		20.7			Pock. Chron'r		P. M.
	35.7		30.6					$11^h 56^m 01^s.5 = 3^h 57^m$ by 2007
	45.8		40.4					56 40.9 55 1062
	56		50.6					58 17.3 57 740
H. R.	06	H R.	00.6			Deduced hourly rate (between 6^h and 12^h) $= +^s.14$		
	16		10.6					
	25.9		20.6					
	35.8		30.3					at $11^h 0^m$ temp. $\begin{cases}24^\circ.5\\23.5\end{cases}$
	45.9		40.2					bar. $29^{in}.700$ at $27^\circ.8$
10 56	56	10 58	50.3					
10 56	05.92	10 58	00.52					

Experiments, set 3, face 1. September 27 A. M.

L.	R.	L.	R.	
10 18 48	10 21 12.8	10 24 41	10 26 46	at $10^h\ 18^m$ arc $\{2°.05$
58.3	22.8	51.2	56	temp. $\{16°.0$ $\{1.97$
08	32.5	01.5	06	17.8
18	4[illegible].5	11.3	16	bar. $29^{in}.752$ at 21°.5
28	52.8	21	26	
A. S. 38.5	A. S. 03	A. S. 31.3	A. [illegible] 36	
48	12.8	41	45.8	
57.8	22.5	5[illegible]	56	
08	32.5	[illegible].3	06	
18	42		16	at $10^h\ 29^m$ arc $\{1°.72$, 1.60
10 20 27.8	10 22 52.5	10 26 21	10 28 26	
10 19 38.04	10 22 02.61	10 25 31.15	10 27 35.98	
10 31 56.7	10 34 39.3	10 3[illegible] [illegible].2	10 39 48.5	at $10^h\ 42^m$ arc $\{1°.40$, 1.32
06.8	49.3	26	58.4	
16.8	59.1	35.9	08.7	
26.8	09.4	45.8	18.7	
36.7	19.2	56	28.5	
H. R. 46.5	H. R. 29.2	H. R 06	H R. 38.7	
56.6	39.3	16	48.6	
06.8	49.2	25.8	58.6	
17.0	59.2	35.7	08.5	
27.0	09.1	45.8	18.5	
10 33 37.0	10 36 19.0	10 38 55.8	10 41 28.5	
10 32 46.79	10 35 29.21	10 38 05.91	10 40 38.56	
10 43 33	10 45 32	2 37 15.3	2 39 11.8	at $2^h\ 38^m$ arc $\{0°.16$
43	41.8	25	21.5	temp. $\{23°.2$ $\{0.10$
53	51.8	35	31.5	21.0
03.2	02	45	41.5	bar. $29^{in}.726$ at 24°.0
13	12	55	51.8	
A. S. 23	A. S. 21.8	A. S. 05	A. S. 01.8	
32.8	31.5	15	11.5	
43	41.8	25	21.8	
53	51.8	35	31.5	
03	02	45	41.5	at $2^h\ 46^m$ arc $\{0°.14$, 0.09
10 45 12.8	10 47 12	2 38 55	2 40 51.3	
10 44 22.98	10 46 21.86	2 38 05.03	2 40 01.59	
2 41 30.5	2 43 31.2	2 46 20	2 48 16.7	
40.8	41	29.9	26.7	
50.5	51	40	36.8	
00.5	01	49.8	46.8	
10.5	11	00.1	56.5	
A. S. 20.5	A. S. 21	H. R. 10	H. R. 06.7	
30.5	31	20.2	16.6	
40.5	41	30	26.6	
50.5	51	40	36.6	
00.5	00.8	49.7	46.4	
2 43 10.3	2 45 11	2 48 00	2 49 56.6	
2 42 20.51	2 44 21.00	2 47 09.97	2 49 06.64	

L.	R.	L.	R.	
2 50 23.7	2 52 21			
33.5	31.2			
43.3	41			
53.5	53.8			
03.6	3.7			
H. R. 13.6	H. R. 13.9			
23.3	23.8			
33.5	33.9			
43.3	43.8			
53.3	53.8			
2 52 03.4	2 54 01.0			
2 51 13.45	2 53 13.90			

Chronometer comparisons

	A. M.		
Pock. Chron'r	9^h 34^m $03^s.7$ =	1^h 35^m by	2007
	35 42.8	34	1062
	36 49.7	35	740
	P. M.		
	3 41 04.5	7 42	2007
	42 42.7	41	1062
	46 49.8	45	740

Deduced hourly rate (between 9^h and 3^h) = + ·02

Experiments, Set 4, face 3 September 28.

L.	R.	L.	R.	
0 50 53.5	0 52 48	0 55 01	0 56 53.8	at 0^h 50^m arc { 1°.56
03.5	58	11	03.8	{ at 0 40 { 1.38
13.3	08.5	21	13.8	temp. { 20°.2
23.3	18	31	23.5	{ bar. $29^{in}.536$ at 27°.5 { 21.0
33	28	41	33.5	The time was noted when the
A. S. 43.3	A. S. 38	A. S. 51	A. S. 43.5	knife-edge passed a mark 0°.1
53.2	48	01	53.5	to the left (in inverting tele-
03.5	58	11	03.5	scope) from the zero line. The
13.2	08.2	20.8	13.5	elongations were equal on
23	18	30.8	23.3	either side of this mark.
0 52 33	0 54 28	0 56 40.8	0 58 33.3	
0 51 43.25	0 53 38.06	0 55 50.95	0 57 43.55	at 0^h 59^m arc { 1°.42 { 1.22
1 00 28.3	1 02 23	1 04 18	1 06 22.7	
38.3	33.2	28	32.5	at 1^h $08\frac{1}{2}^m$ arc { 1°.23 { 1.03
48.3	43.1	37.8	42.6	
58.3	53.2	47.8	52.6	
08.3	03.2	57.9	02.8	
H. R. 18.2	H. R. 13.2	H. R. 08	H. R. 12.7	
28.2	23.2	17.9	22.6	
38.1	33	27.8	32.5	
48.2	43	37.9	42.4	
58.2	52.9	47.7	52.5	
1 02 08.3	1 04 03.2	1 05 57.9	1 08 02.6	
1 01 18.24	1 03 13.11	1 05 07.88	1 07 12.59	
1 10 17.3	1 12 10.3	1 36 58	1 38 52.5	at 1^h 42^m { 25°.7
27.3	20	08	02.8	temp. { 24.0
37	29.8	18	12.8	
47	39.8	28	22.5	
57	49.8	38.2	32.5	
A. S. 07.2	A. S. 00	A. S. 48	A. S. 42.5	
17	10	58	52.5	
27	20	08	02.8	
37	29.8	18	12.8	
47	39.8	27.8	22.5	
1 11 57	1 13 49.5	1 38 37.8	1 40 32.5	
1 11 07.07	1 12 59.89	1 37 47.98	1 39 42.61	

L.	R.	L.	R.	
2 43 50.5	2 45 57	5 00 32.3	5 02 25	at 2h 50m
00.3	07	42	35	temp. (26°.7
10.2	17	52	45	(24.3
20.3	27	02.5	55	bar. 29in.516 at 29°.3
30	37	12	05	
A. S. 40	A. S. 46.8	A. S. 22	A. S. 15	
50	56.8	32.3	25	
00	06.8	42.2	34.8	
10.5	16.5	52	45	at 5h 0m arc (0°.22 (0.02
20	26.5	02.5	55	(26°.5
2 45 30	2 47 36.5	5 02 12.3	5 04 05	temp. (24.3
2 44 40.16	2 46 46.81	5 01 22.19	5 03 14.98	bar. 29in.508 at 32°.5
5 04 32	5 06 26.8	5 09 21.3	5 11 19.9	
42	36.8	31.4	30.	
52	46.8	41.3	39.8	
02	56.8	51.3	50	
12	06.8	01.7	00.2	
A. S. 21.8	16.5	H. R. 11.2	H. R. 10.2	
31.5	26.5	21.3	20.1	
41.8	36.5	31.2	30.2	
51.3	46.5	41.3	40.2	
02	56.5	51.3	50.2	
5 06 12	5 08 06.5	5 11 01.3	5 13 00.1	
5 05 21.87	5 07 16.64	5 10 11.33	5 12 10.08	
5 13 39	5 15 35.3			Chronometer comparisons
48.7	45.3			
58.7	55.6		Pock. Chron'r	0h 4m 8s.3 = 4h 5m by 2007
08.9	05.4			4 45.2 3 1062
18.8	15.5		Deduced hourly rate (between 0h and 5h) = +s.05	5 22.7 4 710
H. R. 28.5	H. R. 25.3			
38.6	35.6			4 39 8.8 8 40 2007
48.6	45.3			40 45.2 39 1062
58.7	55.3			41 22.3 40 710
08.8	05.4			
5 15 18.8	5 17 15.5			
5 14 28.74	5 16 25.41			

Experiments, set 5, face 3. September 29.

0 45 43.5	0 47 32.8	0 49 25.3	0 51 24	at 0h 44½m arc (1°.96
53.8	42.5	35.3	34	(1.76
03.8	52.5	45.3	44	temp. (14°.8
13.8	02.8	55.3	54	(15.8
23.5	12.8	05.3	04	bar. 29in.596 at 14°.2
A. S. 33.5	A. S. 22.5	A. S. 15.3	A. S. 14	
43.5	32.5	25.5	24	
53.5	42.3	35	34	
3.5	52.5	45.3	44	(1°.73
13.5	02.5	55.3	54	at 0h 53½m arc
0 47 23.5	0 49 12.5	0 51 05.5	0 53 04	(1.55
0 46 33.58	3 48 22.56	0 50 15.31	0 52 14.03	

L.		R.		L.		R.		
0 54	05.2	0 56	21.7	0 58	28.4	1 01	21.1	at $1^h\ 02\frac{1}{2}^m$ arc $\{1^\circ.52$
	15.2		31.6		38.2		31.1	1.28
	25.2		41.4		48.2		40.9	
	34.9		51.4		58.2		51	
	44.8		01.4		08.4		01.2	
H. R.	54.8	H. R.	11.7	H. R.	18.2	H. R.	11.2	
	04.9		21.5		28.2		21.1	
	14.8		31.4		38.2		31	
	24.8		41.4		48.2		40.8	
	34.6		51.4		58.2		50.8	
0 55	44.8	0 58	01.5	1 00	08.3	1 02	01.0	
0 54	54.91	0 57	11.49	0 59	18.25	1 01	11.02	
1 03	23.5	1 05	16.5	4 51	19	4 53	25.5	at $4^h\ 51^m$ arc $\{0^\circ.21$
	33.5		26.5		28.8		35.5	0.02
	43.5		36.5		38.8		45.5	at $4^h\ 50^m$
	53.5		46.5		48.8		55.5	temp. $\{14^\circ.5$
	04		56.5		58.5		5.5	16.6
A. S.	13.5	A. S.	06.5	A. S.	08.5		15.5	bar. $29^{in}.658$ at $20^\circ.0$
	23.5		16.5		18.5		25.5	
	33.5		26.5		28.5		35	
	43.3		36.5		38.5		45.3	
	53.5		46.5		48.5		55.5	
1 05	03.5	1 06	56.2	4 52	58.8	4 55	05.5	
1 04	13.53	1 06	06.47	4 52	08.65	4 54	15.44	
4 55	24	4 57	17	4 59	39.7	5 01	40.4	at $4^h\ 59^m$ arc $\{0^\circ.24$
	34		27		49.6		50.4	0.01
	44		37		59.8		00.6	
	54		47		09.9		10.7	
	04.3		57		19.9		20.6	
A. S.	14	A. S.	07	H. R.	30	H. R.	30.6	
	24		17		39.6		40.3	
	34		27		49.6		50.4	
	44		37		59.8		00.4	
	54		46.8		09.8		10.4	
4 57	04.5	4 58	57	5 01	19.8	5 3	20.4	
4 56	14.07	4 58	06.98	5 00	29.77	5 02	30.47	
5 03	33.3	5 05	24					
	43.2		34					
	53.1		43.8					
	03.3		53.8					
	13.2		04.1					
H. R.	23.2	H. R.	14					
	33.2		24.2					
	43.2		34					
	53.2		43.8					
	03.3		53.8					
5 05	13.2	5 07	04.0					
5 04	23.25	5 06	13.95					

During the last sets of observations a very heavy gale shook the skins with which the observatory is lined, but it appeared not to affect the motion of the pendulum.

Chronometer comparisons

Pock.				Chron'r		
0^h	08^m	$12^s.0$	$= 4^h$	9^m	by	2007
	8	47.1		7		1062
	9	24.0		8		740
4	31	13.2	8	32		2007
	32	47.8				1062
	33	25.2				740

Deduced hourly rate (between 0^h and 4^h) $= -^s.17$

Experiments, set 6, face 3, October 2

L.		R.		L.		R.		
10 12	32	10 14	32	10 16	25.5	10 18	20.8	at $10^h\ 11^m$ arc { 1 9.5
	42		33		35.8		30.5	1.75
	52		43		45.5		40.5	
	02		53		56		50.5	at $10^h\ 0^m$
	12		03		06		00.5	temp { 15.0
A. S.	22	A. S.	13	A. S.	15.8	A. S.	10.5	bar. $29^{in}.762$ at 22.0 { 16.0
	32		23		25.5		20.5	
	42.3		33		35.5		30.5	
	52		43		45.5		40.5	
	02		53		55.5		50.5	at $10^h\ 20\frac{1}{2}^m$ arc { 1 69
10 14	12	10 16	03	10 18	05.5	10 20	00.5	1 19
10 13	22.03	10 15	13.00	10 17	15.65	10 19	10.53	
10 22	13.2	10 24	45.8	10 26	50.6	10 28	47.3	at $10^h\ 31^m$ arc { 1 47
	23.2		55.8		00.7		57.4	1 25
	33.1		06		10.8		07.7	
	43		16		20.7		17.5	
	53.2		25.9		30.7		27.4	
H. R.	3.2	H. R.	35.8	H. R.	40.6	H. R.	37.4	
	13.2		45.8		50.6		47.4	
	23.2		55.7		00.7		57.5	
	33		05.9		10.7		07.5	
	43.2		16		20.7		17.5	
10 23	53.2	10 26	25.7	10 28	30.6	10 30	27.3	
10 23	03.15	10 25	35.85	10 27	40.67	10 29	37.45	
10 31	54	10 34	07	2 15	46.5	2 17	47.0	at $2^h\ 15^m$ arc { 0 23
	04		17		56.5		57.3	temp. { 23.2 { 0.03
	14		26.8		06.8		07.3	21.0
	24		37		16.5		17.5	bar. $29^{in}.828$ at 30.5
	34		46.8		26.5		27.5	
A. S.	44	A. S.	56.5	A. S.	36.5	A. S.	37.5	
	54		06.5		46.5		47.3	
	04		16.8		56.5		57.5	
	14		26.8		06.8		07.3	
	24		36.5		16.5		17.3	
10 33	34	10 35	46.5	2 17	26.5	2 19	27.3	
10 32	45.00	10 34	56.75	2 16	36.55	2 18	37.35	
2 19	46	2 21	38.8	2 24	15.7	2 26	10.5	
	56		48.8		25.6		20.4	
	06.3		59		35.4		30.4	
	16.3		09		45.3		40.3	
	26.1		18.8		55.4		50.2	
A. S.	36	A. S.	28.8	H. R.	05.6	H. R.	00.2	
	46		38.8		15.6		10.4	
	56		48.5		25.5		20.3	
	06		58.8		35.2		30.2	
	16.3		08.8		45.4		40.2	
2 21	26	2 23	18.8	2 25	55.4	2 27	50.1	
2 20	36.09	2 22	28.81	2 25	05.46	2 27	00.29	

L.	R.		
2 27 59.2	2 29 51.8		at $2^h\ 30^m$ arc $0°.21$
09.3	01.8		0.01
19.1	11.8		Comparison of chronometers
29	21.8	Pock. chronom'r	$9^h\ 32^m\ 25^s.7 = 1^h\ 33^m$ by 2007
39.1	31.7		33 55.5 32 1062
H. R. 49.1	H. R. 41.7		35 32.8 34 740
59.1	51.7		
09.1	01.8	N. B. Of this set no use has been made.	The chronometer changed its correction $2^m\ 10^s$ between 9 A.M. and 3 P. M. (October 2). For later comparisons see further on.
19	11.8		
29	21.7		
2 29 39	2 31 31.7		
2 28 49.09	2 30 41.75		

Experiments, set 7, face 3. October 2.

2 46 49.5	2 48 42	2 50 39	2 52 37.5	at $2^h\ 46^m$ arc $1°.83$
59.8	52.3	49	47.5	1.62
09.5	02	59	57.8	
19.5	12.3	09.3	07.8	
29.5	22	19	17.8	
A. S. 39.5	A. S. 32	A. S. 29	A. S. 27.8	
49.5	42	39	37.8	
59.5	52	49	47.8	
09.5	02	59	57.8	
19.3	12	09	07.8	at $2^h\ 54\frac{1}{2}^m$ arc $1°.55$
2 48 29	2 50 22	2 52 19	2 54 17.8	1.37
2 47 39.46	2 49 32.05	2 51 29.03	2 53 27.75	
2 55 32.3	2 57 23.1	2 59 16	3 01 04.8	at $3^h\ 4^m$ arc $1°.43$
42.2	33.1	26	14.8	1.21
52.2	43.1	35.8	24.7	at $3^h\ 5^m$
02.4	53.1	45.7	34.6	temp. $27°.0$
12.4	03.2	55.8	44.5	24.5
H. R. 22.2	H. R. 13.2	H. R. 05.9	H. R. 54.5	
32.2	23	16	04.7	
42.1	33	25.8	14.6	
52.1	43	35.8	24.5	
02.2	53	45.7	34.4	
2 57 12.3	2 59 03.1	3 0 55.8	3 02 44.5	
2 56 22.24	2 58 13.08	3 0 05.85	3 01 54.60	
(7 8 10)	7 10 12.5	7 12 19	7 14 16	at $7^h\ 7^m$ arc $0°.21$
20	22.5	29	26	0.01
30	32	38.8	35.5	at $7^h\ 5^m$
39.8	42	49	46	temp. $27°.0$
49.8	52	59	56	bar. $29^{in}.840$ at $26°.0$ 23.0
A. S. 59.5	A. S. 02.3	A. S. 09	A. S. 06	
09.8	12.5	19	16.5	
20	22.3	29	25.5	
29.5	32.3	39	35.5	
39.5	42.3	48.8	45.5	
- - - - - -	7 11 52.3	7 13 59	7 15 55.5	
7 08 59.79	7 11 02.27	7 13 08.96	7 15 05.77	

L.	R.	L.	R.	
(7 16 54.5)	7 19 19.2	7 21 21.9	7 23 16.8	Chronometer comparisons
04.8	29.2	32	26.6	Pock. chronom'r
14.8	39.3	42	36.7	3^h 17^m $14^s.7$ = 7^h 20^m by 2007
24.8	49.2	52	46.6	17 43.6 18 1062
34.5	59.2	02.2	56.7	19 21.0 20 740
A. S. 44.4	A. S. 09.2	A. S. 12.2	A. S. 06.8	6 45 15.0 10 48 2007
54.3	19.2	21.9	16.7	46 43.3 47 1062
—[1]	29.2	32.1	26.7	48 21.0 49 740
14.5	39.2	42.1	36.8	[1] 4.4 interpolated
24.5	49.1	51.8	46.5	Deduced hourly rate (between
—	7 20 59.1	7 23 02.0	7 24 56.6	3^h and 7^h) = + $^s.05$
7 17 41.45	7 20 09.19	7 22 12.02	7 24 06.68	

Experiments, set 8, face 4. October 3.

L.	R.	L.	R.	
11 02 02	11 03 58.8	11 05 49.5	11 07 40.5	at 11^h $1\frac{1}{2}^m$ arc { 1°.97
12.3	08.8	59.5	50.5	{ 1.88
22.3	18.8	09.5	00.5	at 11^h 0^m temp. { 18°.2
32	29	19.5	10.5	{ 18.0
42.3	39	29.5	20.5	bar. $29^{in}.810$ at 21.5
A. S. 52	A. S. 49	A. S. 39.5	A. S. 30.5	
02	58.8	49.8	40.5	The time was noted when the
12	09	59.5	50.5	knife-edge No. 4 passed over
22	19	09.5	00.5	a mark 0°.05 to the left (in
32	29	19.5	10.5	inverting telescope) of the zero
11 03 42	11 05 39	11 07 29.5	11 09 20.5	of the arc.
11 02 52.08	11 04 48.93	11 06 39.53	11 08 30.50	
11 11 31.2	11 13 26.0	11 15 16.9	11 17 05.8	at 11^h 10^m arc { 1°.70
40.9	35.9	26.9	15.7	{ 1.60
51	45.8	36.6	25.5	The pendulum gained 6.85 vibra-
01.2	55.8	46.5	35.4	tions in an hour on the pocket
11.2	06	56.7	45.3	chronometer.
H. R. 21.1	H. R. 16.1	H. R. 06.8	H. R. 55.4	
31	26.2	16.8	05.6	
41	35.8	26.6	15.6	
51.1	45.7	36.5	25.5	at 11^h 20^m arc { 1°.47
1.2	55.8	46.5	35.4	{ 1.38
11 13 11.2	11 15 05.9	11 16 56.6	11 18 45.3	
11 12 21.10	11 14 15.91	11 16 06.67	11 17 55.50	
11 20 46	11 22 39	11 52 56.8	11 54 51.3	
56.3	49	06.8	01.5	
06.3	59	16.8	11.5	
16.3	09	26.5	21.3	
26	19	36.5	31.3	
A. S. 36	A. S. 28.8	A. S. 46.5	A. S. 41	
46	38.8	56.5	51.2	
56	49	06.5	01.2	
06	59	16.5	11.2	
16	09	26.5	21	
11 22 25.8	11 24 18.8	11 54 36.5	11 55 31	
11 21 36.06	11 23 28.95	11 53 46.58	11 55 41.23	

L.	R.	L.	R.	
0 47 06.5	0 48 57	2 59 59	3 01 53.5	at 3^h 1^m arc { 0°.19
16 3	07	09.3	03 8	at 3^h 0^m { 0.08
26.5	17	19	13.8	temp. { 20°.5
36.2	27	29	23.5	{ 20.0
46.2	37	39	33 2	bar. 29^{in}.774 at 27°.0
A. S. 56.2	A. S. 47	A. S. 49	A. S. 43.5	
06.2	57	59	53.5	
16	07.2	09	03.8	
26.2	17	19	13.8	
36	27	29	23.5	
0 48 46	0 50 37	3 1 39	3 3 33.5	
0 47 56.21	0 49 47.02	3 0 49.03	3 02 43.58	
3 03 44	3 05 35	3 08 20.3	3 10 09.1	
54.3	45.2	30.2	19.1	
04.5	55.3	40.1	29	
14.5	05.5	50.1	39	
24.5	15.5	00.2	49	
A. S. 34.3	A. S. 25.3	H. R. 10.2	H. R. 59	
44.5	35	20.2	09	
54.3	45.2	30.2	19	
04.5	55	40.1	28.8	
14.5	05.3	50.1	38.7	
3 05 24.5	3 07 15.2	3 10 00.1	3 11 48.6	
3 04 34.40	3 06 25.23	3 09 10.16	3 10 58.94	Chronometer comparisons
				Pock. chron'r
3 12 02	3 14 18.3		Deduced hourly rate (between 10^h and 4^h) = + ^{s}.06	10^h 08^m $16^s.8$ = 2^h 11^m by 2007
11.9	28.3			09 43.7 10 1062
21.8	38.3			10 21.7 11 740
31.7	48.3			
41.5	58.3			1 04 17.0 5 7 2007
H. R. 51.5	H. R. 08.6			04 43.8 5 1062
01.7	18.4			05 21.2 6 740
11.7	28.4			
21.5	38.4			4 37 17.1 8 10 2007
31.4	48.2			38 43.7 39 1062
3 13 41.5	3 15 58.2			39 21.3 40 740
3 12 51.65	3 15 08.34			

Experiments, set 9, face 4. October 4.

11 20 44.8	11 22 38	11 24 34.8	11 26 25.5	at 11^h 20^m arc { 1.°77
54.8	48	44.8	35.3	{ 1.63
05.2	57 8	54.5	45	at 11^h 15^m temp. { 23°.0
15	08	04.5	55.3	{ 23.7
25	18	14.5	05.5	bar. 29^{in}.966 at 30°.0
A. S. 35	A. S 28	A. S. 24.5	A. S 15.5	
44.8	38	34.5	25 3	
54.8	48	44.5	35.3	
04.8	57.8	54.5	45.2	
14.8	07.8	04.5	55.2	at 11^h $28\frac{1}{2}^m$ arc { 1°.5
11 22 24.8	11 24 18	11 26 14.5	11 28 05.5	{ 1.43
11 21 34.89	11 23 27.95	11 25 24.55	11 27 15.33	

L.		R.		L.		R.		
11 29	36.2	11 31	39	11 33	25.8	11 35	20.3	
	46.1		49		35.6		30.5	
	56.1		59		45.6		40.5	
	06.3		09		55.5		50.4	
	16.3		19		05.7		00.4	
H. R.	26.2	H. R.	29.1	H. R.	15.8	H. R.	10.5	
	36.2		38.9		25.7		20.5	
	46.2		48.8		35.6		30.5	
	56.1		58.8		45.4		40.4	
	06.2		08.9		55.4		50.3	
11 31	16.2	11 33	18.8	11 35	05.7	11 37	00.4	
11 30	26.19	11 32	28.94	11 34	15.62	11 36	10.43	
3 55	29	3 57	29.8	3 59	26.3	4 01	19.5	at 3^h 55^m arc { 0′.14
	39		39.5		36.3		29.3	{ 0.04
	49		49.5		46.5		39.3	at 4^h 0^m temp. { 26°.0
	59		59.8		56.5		49.2	bar 30^{in}.010 at 33°.0 { 25.0
	09.3		09.8		06.5		59.5	
A. S.	19	A. S.	19.5	A. S.	16.6	A. S.	09.3	
	29		29.6		26.5		19.3	
	39		39.5		36.5		29.3	
	49		49.5		46.5		39.3	
	59		00		56.5		49.3	
3 57	09	3 59	9.8	4 01	06.5	4 02	59.5	
3 56	19.03	3 58	19.66	4 00	16.47	4 02	09.35	Chronometer comparisons
4 05	22	4 07	16.9	4 09	09.7	4 11	04.4	Pock. Chron'r
	31.9		26.8		19.7		14.5	10^h 25^m 18^s.8 = 2^h 28^m by 2007
	41.7		36.6		29.6		24.3	26 44.0 27 1062
	52		46.5		39.3		34.2	27 22.0 28 740
	02		56.7		49.2		44.2	
H. R.	12	H. R.	06.8	H. R.	59.6	H. R.	54.2	4 51 21.1 8 54 2007
	22		16.7		09.5		04.3	52 15.4 53 1062
	31.8		26.7		19.6		14.3	53 23.5 54 740
	41.7		36.5		29.5		24.2	Deduced hourly rate (between
	51.8		46.4		39.2		34.2	10^h and 5^h) = — 21
4 07	01.8	4 8	56.4	4 10	49.2	4 12	44	
4 06	11.88	4 08	16.64	4 09	59.46	4 11	54.25	

Experiments, set 10, face 2. October 5.

10 56	10.3	10 58	05	11 00	03.8	11 01	56.5	at 10^h $55\frac{1}{2}^m$ arc { 1′.92
	20		15		13.5		06.5	{ 1.76
	30		25		23.5		16.5	at 10^h 30^m temp. { 24°.8
	40		34.8		33.5		26.3	{ 24.2
	50		44.8		43.5		36.3	bar. 29^{in}.970 at 27°.0
A. S.	00	A. S.	54.8	A. S.	53.5	A. S.	46.3	
	10		05		03.5		56.3	
	20		15		13.5		06.5	
	30		24.5		23.3		16.5	
	40		34.8		33.3		26.3	at 11^h 4^m arc { 1°.68
10 57	50	10 59	44.5	11 01	43.3	11 03	36.3	{ 1.52
10 57	00.03	10 58	54.84	11 00	53.47	11 02	46.39	

L.	R.	L.	R.	
11 05 34.8	11 07 32	11 09 28.5	11 11 19.4	at 11^h 14^m are { 1.48
45	41.7	38.3	29.6	{ 1.32
55.1	51.8	48.4	39.3	
05.2	01.8	58.5	49.3	
15.2	12	08.7	59.5	
H. R. 25.2	H. R. 21.8	H. R. 18.6	H. R. 09.6	
35	31.6	28.5	19.1	
45	41.7	38.5	29.4	
54.8	51.7	48.4	39.2	
05.1	01.7	58.5	49.2	
11 07 15	11 09 11.7	11 11 08.4	11 12 59.3	
11 06 25.04	11 08 21.77	11 10 18.48	11 12 09.39	
11 14 12	11 16 07	11 55 37.5	11 57 40	
22	17.2	47.8	50.2	
32	27	57.5	00.2	The pendulum gained 6^s.62 on
42	37	07.5	10.3	the chronometer in one hour.
52	47	17.3	20.3	
A. S. 02.2	A. S. 57	A. S. 27.3	A. S. 30.3	
12	07	37.3	40	
22	17	47.3	50	
32	26.7	57.5	00.2	
42	36.8	07.3	10.2	
11 15 52	11 17 46.8	11 57 17.3	11 59 20.3	
11 15 02.02	11 16 56.95	11 56 27.42	11 58 30.18	
0 49 58	0 51 58.5	3 43 50	3 45 53	at 1^h 0^m temp. { 29°.0
08.3	08.5	00.2	03	bar. 29^{in}.950 at 31°.5 { 26.8
18	18.5	10.3	13	
28	28.5	20.3	22.8	
37.8	38.3	30	32.8	
A. S. 48	A. S. 48.5	A. S. 40	A. S. 42.8	
58	58.5	50	52.8	
07.8	08.5	00.2	02.5	at 3^h 43^m are { 0°.22
18	18.8	10.3	12.8	{ — 0.03
27.8	28.8	20.2	22.5	at 3^h 40^m temp. { 30°.0
0 51 37.5	0 53 38.5	3 45 29.8	3 47 32.5	bar. 29^{in}.908 at 30°.0 { 27.0
0 50 47.93	0 52 48.54	3 44 40.12	3 46 42.77	
3 47 43.5	3 49 36.2	3 52 31.1	3 54 39.8	
53.6	46.2	41.2	49.8	
03.5	56.3	51.2	00	
13.5	06.5	01.4	10.1	
23.5	16.8	11.3	20.1	
A. S. 33.2	A. S. 26.2	H. R. 21.3	H. R. 29.8	
43.2	36.2	31	39.8	
53.5	46.2	41	49.8	
03.6	56.3	51.2	00	
13.5	06.5	01.4	10.2	
3 49 23.5	3 51 16.3	3 54 11.2	3 56 19.9	
3 48 33.46	3 50 26.34	3 53 21.21	3 55 29.94	

L.	R.	L.	R.	
3 56 34.5	3 58 31.5			Comparison of chronometers
44.6	41.4		Pock. Chron'r	9h 57m 22s.8 = 2h 0m by 2007
54.8	51.5			57 46.0 1 58 1062
04.8	01.8			59 24.3 2 0 740
14.8	11.7			
H. R. 24.6	21.4			4 33 23.5 8 36 2007
34.5	31.2			34 45.9 35 1062
44.6	41.3			36 24.2 37 740
54.7	51.2			
04.8	01.3			Deduced hourly rate (between
3 58 14.7	4 00 11.5			10h and 4h) = + .03
3 57 24.67	3 59 21.44			

Experiments, set 11, face 2. October 6.

L.	R.	L.	R.	
10 51 19.5	10 53 14.2	10 55 11.2	10 57 12	at 10h 48m arc ([illegible] 83
29.5	24	21	22	([illegible] 62
39	34	31	31.5	at 10h 35m temp. (20 [illegible]
49.3	43.8	40.8	41.5	(22 0
59.5	54.2	50.8	51.5	bar. 29in.760 at 2[illegible] 0
A. S. 09.5	A. S. 04.3	A. S. 01	A. S. 02	
19.5	14.3	11	12	
29.3	24	21	21.5	
39	34	30.5	31.5	
49	44	40.5	41.5	at 10h 59m arc ([illegible]
10 52 59.2	10 54 54.2	10 56 50.5	10 58 51.5	(1 [illegible]
10 52 09.30	10 54 04.09	10 56 00.85	10 58 01.68	
11 03 16.5	11 05 11.2	11 07 26	11 09 20.4	at 11h 12m arc ([illegible] 34
26.3	21.2	35.6	30.5	(1 12
36.2	31.2	45.6	40.5	at 11h [illegible] temp. (21 7
46.2	41.1	55.6	50.6	bar. 29in.7[illegible] at [illegible] (27 0
56.3	51	05.7	00.5	
H. R. 06.3	H. R. 01	H. R. 15.7	H. R. 10.5	
16.3	11.1	25.7	20.4	
26.2	21.1	35.[illegible]	30.4	
36.2	31	45.[illegible]	40.4	
46	41	5[illegible]	50.3	
11 04 56.2	11 06 51	11 09 05.[illegible]	11 11 00.4	
11 04 06.25	11 06 01.08	11 08 [illegible]	11 10 10.45	
11 49 09	11 51 04	3 18 [illegible]	3 19 56.5	at 3h 18m arc (0 22
19	13.8	14	06.6	(−0 02
29	23.5	24	16.5	at 3h 20m temp. (27 [illegible]
38.8	33.5	34	26.7	bar. 29in.772 at 33 0 (24 2
49	43.5	44	36.5	
A. S. 59	A. S. 53.8	A. S. 54	A. S. 46.5	
09	03.8	04	56.5	
19	13.8	14	06.5	
29	23.5	23.8	16.5	
39	33.5	33.8	26.5	
11 50 48.8	11 52 43.3	3 19 43.8	3 21 36.5	
11 49 58.96	11 51 53.64	3 18 53.95	3 20 46.53	

L.	R.	L.	R.	
3 21 49.5	3 23 42	3 27 34.8	3 29 31.6	
59.5	52.3	45	41.6	
09.8	02.3	55	51.6	
19.5	12.3	05	01.6	
29.6	22.3	15	11.7	
A. S. 39.5	A. S. 32.2	A. S. 24.9	A. S. 21.4	
49.5	42.3	34.8	31.4	
59.5	52.2	44.7	41.4	
09.5	02.3	54.8	51.5	
19.5	12.2	04.8	01.5	
3 23 29.5	3 25 22	3 29 14.8	3 31 11.5	
3 22 39.54	3 24 32.21	3 28 24.87	3 30 21.53	
3 31 20.3	3 33 13.2			Chronometer comparisons
30.3	23.2			Pock. Chronom'r
40.3	33			10^h 08^m $25^s.1 = 2^h$ 11^m by 2007
50.3	43			09 46.2 10 1062
00.3	53.1			10 24.9 11 740
H. R. 10.3	H. R. 03.2			
20.3	13.2			4 45 25.9 8 48 2007
30.2	23			46 46.4 47 1062
40.2	33			47 25.2 48 740
50.2	43			Deduced hourly rate (between
3 33 00.2	3 34 53.1			10^h and 4^h) = — $0^s.01$
3 32 10.26	3 34 13.09			

Experiments, set 12, face 2. October 8.

10 50 [illegible]	10 52 00	10 54 01	10 56 25.8	at 10^h $49^m.5$ arc { 1°.97
21.2	10.2	11	35.5	{ 1.75
31.2	20	21	45.3	at 10^h 35^m temp. { 25°.8
41	30	30.8	55.5	{ 25.0
51	40	40.7	05.5	bar. $30^{in}.064$ at 26°.8
A. S. 01	A. S. 50	A. S. 50.5	A. S. 15.5	
11.2	00	00.8	25.5	
21	10	10.8	35.5	
31	20	20.5	45.3	
41	30	30.6	55.3	at 10^h $58^m.5$ arc { 1°.74
10 51 51	10 53 39.8	10 55 40.5	10 58 05.5	{ 1.52
10 51 01.08	10 52 50.00	10 54 50.75	10 57 15.47	
10 59 22.3	11 01 21	11 03 11.9	11 05 12.6	
32.2	31	21.6	22.6	
42.2	41	31.8	32.5	
52.2	50.9	41.8	42.5	
02.2	01	51.6	52.1	
H. R. 12.2	H. R. 11	H. R. 01.8	H. R. 02.5	
22.2	21	11.8	12.6	
32.2	30.7	21.7	22.4	
42	40.8	31.6	32.4	
52	50.7	41.7	42.[illegible]	
11 01 02.1	11 03 00.9	11 04 51.5	11 06 52.2	
11 00 12.16	11 02 00.91	11 04 01.71	11 06 02.45	

L.	R.	L.	R.	
2 58 25.8	3 00 20.5	3 02 13	3 04 04	at 3^h 6^m are {0 .22
35.5	30.5	23	14	{0.02
45.5	40.2	33	23.8	temp. {26°.3 bar. 30^{in}.012 at 34.0
55.5	50.3	43	33.8	{28.5
05.5	00.5	53	43.5	
A. S. 15.5	A. S. 10.5	A. S. 03.2	A. S. 54	
25.5	20.2	13	04	
35.5	30.2	23	14	
45.5	40.1	32.8	23.5	
55.5	50.2	43	33.8	
3 00 05.5	3 02 00.3	3 03 53	3 05 43.8	
2 59 15.53	3 01 10.32	3 03 03.00	3 04 53.84	
3 06 32.7	(3 08 25.5)	3 10 06.3	3 11 55.2	During these observations the
42.6	35.3	16.3	05.2	wind was strong from the south,
52.6	45.3	26.3	15.2	shaking the observatory.
02.7	55.3	36.3	25.2	
12.7	05.5	46.2	35	Chronometer comparisons
H. R. 22.6	H. R. 15.4	H. R. 56.2	45	10^h 09^m $0^s.8 = 2^h$ 11^m by 2007
32.5	25.3	06.2	55	10 43.3 11 1062
42.4	35.3	16.2	05	11 22.6 12 740
52.3	45.2	26.2	15.1	4 14 00.7 8 16 2007
02.3	55.2	36.3	25.1	14 43.0 15 1062
3 08 12.5	----	3 11 46.1	3 13 35.4	16 22.3 17 740
3 07 22.54	3 09 15.33	3 10 56.24	3 12 45.10	hourly rate (between 10^h and 4^h) $= +0^s.09$

Experiments, set 13, face 2. October 9.

L.	R.	L.	R.	
11 12 55.5	11 14 50	11 16 41	11 18 30	at 11^h 12^m are {1.87
05.5	00.2	51	40	{1.68
15.5	10.3	01	50	at 11^h 0^m temp. {25°.8
25.3	20.2	11	00	bar. 30^{in}.126 at 27 .5 {25.6
35.5	30.2	21	10	
A. S. 45.3	A. S. 40.2	A. S. 31	A. S. 20	
55.3	50	40.8	29.8	
05.3	00	51	39.8	
15.5	10.2	01	49.8	
25.3	20	11	59.8	at 11^h $20\frac{1}{2}^m$ are {1 .62
11 14 35.3	11 16 30.1	11 18 21	11 20 09.5	{1.44
11 13 45.39	11 15 40.13	11 17 30.98	11 19 19.88	
11 21 34.4	11 23 21.3	11 25 14.2	11 27 13.1	
44.6	31.2	24	22.8	
54.5	41.2	34	32.8	
04.6	51.2	43.8	42.7	
14.5	01.2	54	52.7	
H. R. 24.4	H. R. 11.2	H. R. 04.1	H. R. 02.8	
34.3	21.1	14.1	12.8	
44.3	31.2	24	22.7	
54.3	41	33.8	32.6	
04.4	51.2	43.7	42.7	
11 23 14.4	11 25 01.2	11 26 53.8	11 28 52.6	
11 22 24.43	11 24 11.18	11 26 03.95	11 28 02.75	

L.	R.	L.	R.	
3 25 19.3	3 27 12	3 29 03	3 30 55.8	at $3^h\ 25^m$ arc $0^{\circ}.22$
29.5	22	13	05.8	temp. $29^{\circ}.5$ 0.02
39.2	32	23	51.5	27.5
49.2	42	32.8	25.5	bar. $30^{in}.070$ at $30^{\circ}.0$
59.3	52	42.5	35.5	
A. S. 09.5	A. S. 02.2	A. S. 52.8	A. S. 45.5	
19.5	12	02.8	55.5	
29.3	22	12.8	05.5	
39.3	32	23.8	·15.5	
49	42	32.8	25.5	at $3^h\ 33^m$ arc $0^{\circ}.21$
3 26 59	3 28 52	3 30 42.5	3 32 35.5	0.01
3 26 09.28	3 28 02.02	3 29 52.80	3 31 45.55	
3 33 32.5	3 35 27.3	3 37 16	3 39 18.9	Chronometer comparisons
42.4	37.2	26.2	28.8	Pock. Chronom'r
52.2	47.2	35.8	38.6	$10^h\ 36^m\ 1^s.2 = 2^h\ 38^m$ by 2007
02.4	57.1	45.7	48.5	37 41.8 38 1062
12.4	07.1	55.8	58.8	38 21.6 39 740
H. R. 22.4	H. R. 17.1	H. R. 05.9	H. R. 08.8	
32.3	27.2	16	18.8	4 07 1.7 8 9 2007
42.3	37	26	28.8	09 41.7 10 1062
52.2	47.2	35.8	38.5	10 21.7 11 740
02.2	57.2	45.6	48.4	Deduced hourly rate (between
3 35 12.2	3 37 07.1	3 38 55.7	3 40 [illegible]	10^h and 4^h) = $+^s.03$
3 34 22.32	3 36 17.15	3 38 05.86	3 40 08.67	
Experiments, set 14, face ♯. October 10.				
12 00 52.5	12 02 45	12 04 36	12 06 31	at $12^h\ 0^m$ arc $1^{\circ}.52$
02.5	55.3	46	41	temp. $21^{\circ}.0$ 1.42
12.5	05.3	56	51	20.5
22.3	15.3	06.2	01	
32.3	25	16	11	bar. $30^{in}.204$ at $19^{\circ}.7$
A. S. 42.3	A. S. 35	A. S. 26	A. S. 21	The pendulum gained 6.6 vibrations in an hour on the pocket chronometer.
52.2	45	36	30.5	
02.5	55	46	40.5	
12.3	05	56	50.8	
22.2	15	06	00.8	at $0^h\ 8\frac{1}{2}^m$ arc $1^{\circ}.42$
12 02 32	12 04 25	12 06 16	12 08 11	1.26
0 01 42.33	0 03 35.08	0 05 26.02	0 07 20.87	
0 09 47.7	0 11 38.5	0 15 31	0 17 45.5	at $0^h\ 20^m$ arc $1^{\circ}.16$
57.8	48.3	40.8	55.5	[illegible]
07.6	58.2	50.9	05.6	
17.7	08.5	01	15.6	
27.7	18.4	11.1	25.5	
H. R. 37.6	H. R. 28.4	H. R. 21	H. R. 35.5	
47.5	38.2	31	45.4	
57.5	48.2	40.7	55.4	
07.6	58.3	50.6	05.6	
17.6	08.4	00.8	15.6	
0 11 27.5	0 13 18.3	0 17 10.9	0 19 25.5	
0 10 37.62	0 12 28.34	0 16 20.89	0 18 35.52	

L.	R.	L.	R.	
0 20 58	0 22 59	4 11 07	4 13 01.8	at $4^h\ 10^m$ arc {0".19
08.3	09.3	17	11.8	at $4^h\ 19^m$ temp. {24°.5 {0.03
18.2	19	27	21.5	{23.5
28	29	36.5	31.5	bar $30^{in}.168$ at 25°.0
38	39	46.5	41.3	
A. S. 48	A. S. 49	A. S. 56.5	A. S. 51.2	
58.2	59	06.[illegible]	01.2	
08.2	09	16.8	11.3	
18.2	19	26.8	21.3	
28	29.8	36.5	31.3	
0 22 38	0 24 38.6	4 12 46.5	4 14 41.2	
0 21 48.10	0 23 48.97	4 11 56.72	4 13 51.40	
4 14 52	4 16 41	4 19 31.8	4 21 26.5	
02.3	51	41.7	36.6	
12.3	01	51.8	46.4	
22.2	11	01.8	56.5	
32	21	11.8	06.6	
A. S. 42	A. S. 31	H. R. 21.8	H. R. 16.6	
52	41	31.7	26.7	
02.3	51	41.7	36.4	
12.3	01	51.7	46.3	
22.2	11	01.8	56.5	
4 16 32	4 18 21	4 21 11.8	4 23 06.5	
4 15 42.15	4 17 31.00	4 20 21.76	4 22 16.51	
4 23 21.3	4 25 16.2			Chronometer comparisons
31.3	26.2		Pock. chron'r	$11^h\ 42^m\ 3^s.2 = 3^h\ 44^m$ by 2007
41.3	36.2			42 42.3 43 1062
51.2	46.1			43 22.2 44 740
01.3	56.2			
H. R. 11.4	H. R. 06.1			5 04 03.2 9 6 2007
21.2	16.2			04 42.0 5 1062
31.2	26			06 22.5 7 740
41.2	35.8			
51.1	46			Deduced hourly rate (between
4 25 01.4	4 26 56			11^h and 5^h) = $+^s.05$
4 24 11.26	4 26 06.09			

Experiments, set 15, face 4. October 11.

9 01 [illegible]	9 03 14	9 05 01	9 06 51.5	at $9^h\ 1^m$ arc {1°.73
31.2	24	11	01.6	{1.63
41	33.5	21	11.6	at $9^h\ 0^m$ temp. {15°.6
51	43.5	30.8	21.5	{17.0
01.3	54	40.8	31.5	bar $29^{in}.843$ at 15°.0
A. S. 11	A. S. 04	A. S. 50.8	A. S. 41.3	
21	14	01	51.5	
31	24	11	01.5	
41	33.8	21	11.5	
51	43.8	30.8	21.5	at 9^h [illegible] arc {1 .50
9 03 01.2	9 04 53.8	9 06 40.8	9 08 31.[illegible]	{1.42
9 02 11.06	9 04 03.85	9 05 50.91	9 07 41.4[illegible]	

L.	R.	L.	R.	
9 11 00.4	9 12 51.1	9 14 58	9 16 48.5	at 9^h 20^m arc { 1°.32
10.5	01.2	08	58.6	{ 1.22
20.4	11.2	17.9	08.7	
30.2	21.1	28	18.6	
40.2	31.1	37.8	28.7	
H. R. 50.2	H. R. 41.1	H. R. 47.7	H. R. 38.6	
00.2	51.1	57.9	48.6	
10.3	01.1	08	58.5	
20.3	11.1	17.9	08.7	
30.2	21	27.7	18.6	
9 12 40.2	9 14 31	9 16 37.7	9 18 28.6	
9 11 50.28	9 13 41.10	9 15 47.87	9 17 38.61	
1 11 09	1 12 57.8	1 14 48.3	1 16 39	at 1^h 14^m arc { 0°.18
19	07.8	58.3	40	at 1^h 10^m temp. { 20°.0 { 0.03
28.5	17.8	08.3	59	{ 20.0
38.8	27.5	18.3	09.2	bar. 29^{in}.805 at 22.3
48.8	37.5	28.3	19	
A. S. 58.8	A. S. 47.5	A. S. 38	A. S. 29	
08.8	57.5	48.3	39	
18.8	07.5	58.3	49	
28.8	17.5	08.2	59	
38.8	27.5	18.2	09	at 1^h 19^m arc { 0°.14
1 12 48.8	1 14 37.5	1 16 28	1 18 19.2	{ 0.06
1 11 58.81	1 13 47.58	1 15 38.23	1 17 29.04	
1 19 16.1	1 21 04.9	1 22 53.6	1 24 42.2	
26.1	14.9	03.8	52.3	Chronometer comparisons
36	24.8	13.8	02.3	Pock. Chronom'r
46	34.7	23.5	12.3	8^h 24^m 05^s.0 = 0^h 26^m by 2007
56	44.6	33.5	22.2	24 42.9 25 1062
H. R. 06	H. R. 54.7	H. R. 43.5	H. R. 32.1	25 23.1 26 740
16.1	04.8	53.5	42.1	
26.1	14.8	03.5	52.1	0 57 5.7 4 59 2007
35.8	24.7	13.5	02.2	58 42.8 4 59 1062
45.7	34.6	23.4	12.2	59 23.8 5 00 740
1 20 55.8	1 22 44.5	1 24 33.3	1 26 22.1	Deduced hourly rate (between 8^h and 1^h) = —^{s}.06
1 20 05.97	1 21 54.73	1 23 43.54	1 25 32.19	

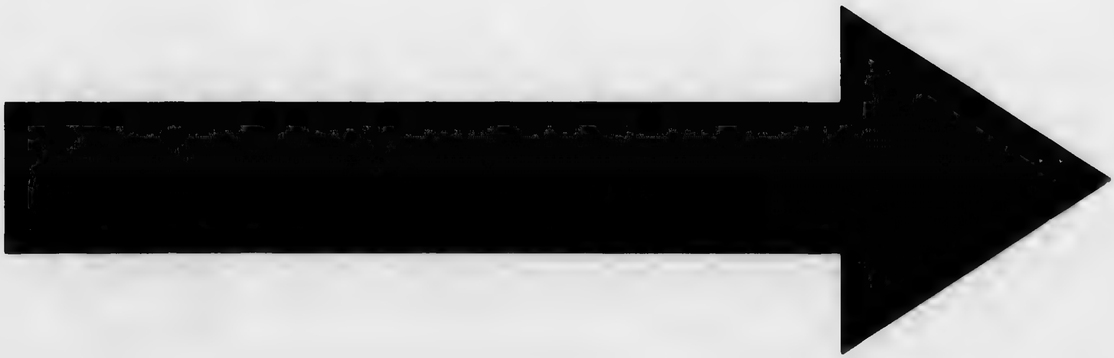
Experiments, set 16, face 1. October 11.

L.	R.	L.	R.	
1 47 43	1 49 32	1 51 22.5	1 53 13.5	at 1^h 47^m arc { 1°.73
53.2	42	32.5	23.8	{ 1.63
03.2	52	42.5	33.5	at 1^h 40^m temp. { 23°.7
13.2	02	52.5	43.5	{ 22.0
23	12	02.8	53.5	bar. 29^{in}.804 at 28°.0
A. S. 33	A. S. 22	A. S. 12.8	A. S. 03.5	
43	32	22.8	13.5	
53	41.8	32.5	23.5	
03	52	42.5	33.5	
13	02	52.5	43.5	at 1^h 55½^m arc { 1°.54
1 49 23	1 51 12	1 53 02.8	1 54 53.5	{ 1.42
1 48 33.05	1 50 21.98	1 52 12.61	1 54 03.53	

L.		R.		L.		R.		
1 56	32.3	1 58	25.1	2 00	14	2 02	00.8	at 2^h [illegible] arc { 1 [illegible]
	42.2		35		23.8		10.8	{ 1.26
	52.2		45		33.8		20.7	
	02.3		55.1		43.6		30.6	
	12.2		05.2		53.7		40.5	
H. R	22.2	H. B	15	H. R.	03.9	H. R	50.4	
	32.1		25.1		13.8		00.6	
	42.2		35		23.8		10.7	
	52.1		44.8		33.8		20.6	
	02.2		55		43.5		30.6	
1 58	12.3	2 00	05	2 01	53.6	2 03	40.5	
1 57	22.21	1 59	15.03	2 01	03.75	2 02	50.62	
6 08	12.2	6 10	32.8	6 12	31.8	6 14	20.5	at 6^h 8^m arc { 0.13
	52		12.8		41.8		30.5	at 6^h 10^m temp. { 24.5 { 0.08
	02.2		52.8		51.8		40.5	{ 25.0
	12.2		02.8		02		50.5	bar. 29^in.786 at 24.0
	22.3		12.8		11.8		00.5	
A. S.	32	A. S.	22.8	A. S.	21.8	A. S.	10.6	
	42		32.8		31.8		20.5	
	52		42.8		41.5		30.5	
	02.3		52.8		51.5		40.5	
	12.2		02.8		01.8		50.3	at 6^h 17^m arc { 0.12
6 10	22	6 12	12.8	6 14	11.5	6 16	00.5	{ 0.08
6 09	32.13	6 11	22.80	6 13	21.65	6 15	10.49	
6 17	09.3	6 19	02.2	6 20	49	6 22	39.6	
	19.4		12.2		59		49.7	
	29.2		22.1		09		59.8	
	39.2		31.9		19		09.8	
	49.2		42		28.9		19.7	
H. R.	59.2	H. R.	52.1	H. R.	38.7	H. R.	29.5	
	09.4		02.2		48.8		39.6	Chronometer comparisons
	19.3		12.2		58.6		49.5	Pock. Chronom'r
	29.1		22		08.8		59.5	5^h 51^m 06^s.5 = 9^h 55^m 1[illegible] 2007
	39.1		31.8		18.8		09.6	52 43.4 53 1062
6 18	49.1	6 20	41.8	6 22	28.7	6 24	19.5	54 25.8 55 710
6 17	59.23	6 19	52.05	6 21	38.85	6 23	29.62	Deduced hourly rate (between 1^h and 6^h) = —^s.19

Experiments, set 17, face 3. October 12.

10 19	25.5	10 21	14.3	10 23	03	10 24	56	at 10^h 19^m arc { 1.56
	35.5		24.3		13		06	{ 1.47
	45.3		34		23		16	at 10^h 18^m temp. { 19.4
	55.5		44		33		25.8	{ 19.2
	05.5		54		43		35.8	bar. 20^in.374 at 19.6
A. S.	15.5	A. S.	04.2	A. S.	53	A. S.	45.8	
	25.5		14.2		03		55.8	
	35.3		24		13		05.8	
	45.3		34		23		15.8	
	55.3		44		33		25.6	at 10^h 27^m arc { 1.39
10 21	05.3	10 22	54	10 24	42.8	10 26	35.6	{ 1.30
10 20	15.41	10 22	04.09	10 23	52.98	10 25	45.82	



L.	R.	L.	R.	
10 27 54.8	10 29 43.3	10 31 33.9	10 33 34.8	at $10^h\ 36^m$ arc { 1°.27
04.9	53.3	44	44.7	1.15
14.8	03.4	54.1	54.8	
24.7	13.4	04.3	14.9	
34.5	23.2	14.2	24.6	
H. R. 44.4	H. R. 33.2	H R. 24	H. R. 34 5	
54.6	43.2	33.8	44.7	
04.7	53.2	43.8	54.8	
14.5	03.3	54	04.8	
24.4	13.2	04.1	14.8	
10 29 34.3	10 31 23.2	10 33 14.1	10 35 24.6	
10 28 44.60	10 30 33.26	10 32 24.03	10 34 24.73	
2 42 35	2 44 30	2 46 18.5	2 48 09.5	at $2^h\ 42^m$ arc { 0°.19
44.8	39.8	28.3	19	temp. { 23°.0 0.02
54.8	49.5	38.3	29.2	21.3
04.8	59.5	48.3	39	bar. $29^{in}.430$ at 50°.0
14.8	09.8	58.2	49	
A. S. 24.8	A. S. 19.5	A. S. 08.3	A. S. 59.2	
34.5	29.5	18.2	09	
44.5	39.5	28.2	19	
54.8	49.5	38	29	
04.8	59.5	48	39	at $2^h\ 50^m$ arc { 0°.15
2 44 14.8	2 46 09.5	2 47 58.2	2 49 49	0.05
2 43 24.76	2 45 19.60	2 47 08.23	2 48 59.08	
2 51 06	2 52 56.8	2 54 45.4	2 56 32	
16.1	06.8	55.4	42.2	Chronometer comparisons
26	16.8	05.5	52.2	Pock. chronom'r
35.8	26.8	15.4	02.2	$9^h\ 57^m\ 10^s.5 = 1^h\ 59^m$ by 2007
45.7	36.5	25.4	12.3	57 46.7 58 1062
H. R. 55.8	H. R. 46.5	H. R. 35.2	H. R. 22.2	58 27.7 59 740
05.8	56.6	45.3	32	
15.8	06.7	55.3	42	2 23 11.8 6 25 2007
25.8	16.6	05.4	52.1	23 47.7 24 1062
35.7	26.6	15.3	02.2	24 28.7 25 740
2 52 45.7	2 54 36.5	2 56 25.3	2 58 12.2	Deduced hourly rate (between
2 51 55.84	2 53 46.65	2 55 35.35	2 57 22.15	10^h and 2^h) = — $0^s.20$

The following table contains the individual results of the observed number of vibrations in a given interval. The first column indicates left or right vibrations, alternately; the second gives the chronometer intervals derived from the preceding means of each set of observations; the third contains the correction for rate of chronometer for the intervals; the fourth the intervals corrected for rate and expressed in seconds of mean time; the fifth the corresponding number of vibrations. These were obtained by working out for each of the 16 sets the number of vibrations the pendulum gained upon the seconds of the chronometer in one hour, thus confining our attention to the successive means of the preceding record and their elapsed times, and subtracting the fraction of seconds of each from the preceding mean (remarking whether the seconds are odd or even) we find, by taking the differences of seconds and corresponding elapsed times collectively, the number of

vibrations in excess of a certain chronometer interval expressed in seconds. When reduced to the corresponding value for one hour, we have—

For face 1 . . . 6.61
" 3 . . . 7.14
" 4 . . . 6.52
" 2 . . . 6.72

and on the average 6.75 vibrations in excess of the number of seconds in an hour. It appears that the rate of the chronometer in sets 1, 3, 7, and 15 differed most from this mean, the 1st and 15th falling short of it, and the other two exceeding it; the number of vibrations for these sets were deduced under the supposition that the motion of the pendulum was more regular than that of the pocket chronometer. The following three columns contain the corrections for arc, temperature, and atmospheric pressure, as explained above. The last column shows the number of vibrations of the pendulum in a mean solar day.

	Chronometer intervals.	Corr'n for rate.	Mean time intervals.	No. of vib'ns.	Corresp. No. in a day.	Corrections for arc.	Corrections for temp.	Corrections for atm. pr.	N.
	Set 1. Face 1. September 26, 1860.								
L.	$3^h\ 51^m\ 59^s.33$	$-1^s.16$	$13918^s.17$	13944	86560.36	+1.06	−11.62	−.01	86549.79
R.	3 51 49.10	−1.16	13907.94	13934	61.88	.96	"	"	51.21
L.	4 00 10.27	−1.20	14409.07	14436	61.48	.90	"	"	50.75
R.	3 59 44.09	−1.20	14382.89	14410	62.84	.84	"	"	52.05
L.	3 59 42.34	−1.20	14381.14	14408	61.36	.75	"	"	50.48
R.	3 59 42.17	−1.20	14380.97	14408	62.38	.70	"	"	51.45
					Mean . . .				86550.95
	Set 2. Face 1. September 26.								
L.	3 19 48.80	+ .47	11989.27	12012	86563.80	+ .76	−11.84	−.02	86552.70
R.	3 19 48.40	+ .47	11988.87	12012	66.68	.72	"	"	55.54
L.	3 19 30.42	+ .47	11970.89	11994	66.76	.67	"	"	55.57
R.	3 19 18.60	+ .47	11959.07	11982	65.66	.64	"	"	54.44
L.	3 18 24.83	+ .46	11905.29	11928	64.80	.58	"	"	53.52
R.	3 18 16.66	+ .47	11897.13	11920	66.08	.55	"	"	54.77
					Mean . . .				86554.42
	Set 3. Face 1. September 27.								
L.	4 18 26.99	+ .09	15507.08	15536	86561.12	+1.16	−13.79	−.02	86548.47
R.	4 17 58.98	+ .09	15479.07	15508	61.46	1.08	"	"	48.73
L.	4 16 49.36	+ .08	15409.44	15438	60.14	.96	"	"	47.29
R.	4 16 45.02	+ .08	15405.10	15434	62.08	.90	"	"	49.17
L.	4 14 23.18	+ .08	15263.26	15292	62.68	.74	"	"	49.61
R.	4 13 37.43	+ .08	15217.51	15246	61.74	.70	"	"	48.63
L.	4 13 07.54	+ .08	15187.62	15216	61.42	.67	"	"	48.28
R.	4 12 35.34	+ .08	15155.42	15184	62.92	.63	"	"	49.74
					Mean . . .				86518.74

	Chronometer intervals.	Corr'n for rate.	Mean time intervals.	No. of vib'ns.	Corresp. No. in a day.	Corrections for arc.	Corrections for temp.	Corrections for atm. pr.	N.
				Set 4. Face 3. September 28.					
L.	4h 09m 38s.94	+ s.21	14979s.15	15008	86566.40	+ .68	—11.66	—.10	86555.32
R.	4 09 36.92	+ .21	14977.13	15006	66.52	.66	"	"	55.42
L.	4 09 30.92	+ .21	14971.13	15000	66.60	.64	"	"	55.48
R.	4 09 33.09	+ .21	14973.30	15002	65.62	.61	"	"	54.47
L.	4 08 53.09	+ .21	14933.30	14962	66.04	.56	"	"	54.84
R.	4 08 56.97	+ .21	14937.18	14966	66.68	.53	"	"	55.45
L.	4 09 20.86	+ .21	14961 07	14990	67.60	.50	"	"	56.34
R.	4 09 12.82	+ .21	14953.03	14982	67.40	.49	"	"	56.13
						Mean . . .			86555.43
				Set 5. Face 3. September 29.					
L.	4 05 35.07	— .70	14734.37	14762	86562.20	+ .96	—15.64	—.05	86547.47
R.	4 05 52.88	— .70	14752.18	14780	62.92	.93	"	"	48.16
L.	4 05 58.76	— .70	14758.06	14786	63.56	.88	"	"	48.75
R.	4 05 52.95	— .70	14752.25	14780	62.52	.84	"	"	47.67
L.	4 05 34.86	— .70	14734.16	14762	63.24	.78	"	"	48.33
R.	4 05 18.98	— .69	14718.29	14746	62.64	.74	"	"	47.69
L.	4 05 05.00	— .69	14704.31	14732	62.70	.70	"	"	47.71
R.	4 05 02.93	— .69	14702.24	14730	63.12	.66	"	"	48.09
						Mean . . .			86547.98
				Set 6. Face 3. October 2.					
L.	4 03 14.52	This set is not used, owing to a defect in the indications of the chronometer.							
R.	4 03 24.35								
L.	4 03 20.44								
R.	4 03 18.28								
L.	4 02 02.31								
R.	4 01 24.44								
L.	4 01 08.42								
R.	4 01 04.30								
				Set 7. Face 3. October 2.					
L.	4 21 20.33	+ .22	15680.55	15710	86562.26	+ .83	—11.14	+.01	86551.66
R.	4 21 30.22	+ .22	15690.44	15720	62.76	.79	"	"	52.12
L.	4 21 39.93	+ .22	15700.15	15730	64.26	.74	"	"	53.57
R.	4 21 38.02	+ .22	15698.24	15728	63.80	.70	"	"	53.07
L.	4 21 22.21	+ .22	15682.43	15712	62.92	.65	"	"	52.14
R.	4 21 56.11	+ .22	15716.33	15746	63.10	.62	"	"	52.29
L.	4 22 06.17	+ .22	15726.39	15756	62.68	.61	"	"	51.86
R.	4 22 12.08	+ .22	15732.30	15762	63.10	.60	"	"	52.27
						Mean . . .			86552.37

	Chronometer intervals.			Corr'n for rate.	Mean time intervals.	No. of vib'ns.	Corresp. No in a day.	Corrections for arc.	temp.	atm. pr.	N.
					Set 8. Face 4. October 3.						
L.	3h	57m	56s.95	+ s.24	14277s.19	14304	86562.24	+1.07	—13.92	.00	86549.39
R.	3	57	54.65	+ .24	14274.89	14302	64.10	1.03	"	"	51.21
L.	3	57	54.87	+ .24	14275.11	14302	62.76	.96	"	"	49.80
R.	3	57	54.73	+ .24	14274.97	14302	63.60	.92	"	"	50.60
L.	3	56	49.06	+ .24	14209.30	14236	62.34	.80	"	"	49.22
R.	3	56	43.03	+ .24	14203.27	14230	62.60	.77	"	"	49.45
L.	3	56	44.98	+ .24	14205.22	14232	62.88	.74	"	"	49.70
R.	3	57	12.84	+ .24	14233.08	14260	63.42	.71	"	"	50.21
								Mean			86549.95
					Set 9. Face 4. October 4.						
L.	4	34	44.14	— .96	16483.18	16514	86561.54	+ .78	—11.58	+.06	86550.80
R.	4	34	51.71	— .96	16490.75	16522	63.72	.74	"	"	52.94
L.	4	34	51.92	— .96	16490.96	16522	62.60	.71	"	"	51.79
R.	4	34	54.02	— .96	16493.06	16524	62.06	.68	"	"	51.22
L.	4	35	45.69	— .96	16544.73	16576	63.28	.63	"	"	52.39
R.	4	35	47.70	— .96	16546.74	16578	63.22	.60	"	"	52.30
L.	4	35	43.84	— .96	16542.88	16574	62.52	.57	"	"	51.57
R.	4	35	43.82	— .96	16542.86	16574	62.62	.55	"	"	51.65
								Mean			86551.83
					Set 10. Face 2. October 5.						
L.	4	47	40.09	+ .14	17260.23	17292	86559.02	+ .89	—10.40	+.05	86549.56
R.	4	47	47.93	+ .14	17268.07	17300	59.86	.85	"	"	50.36
L.	4	47	39.99	+ .14	17260.13	17292	59.52	.79	"	"	49.96
R.	4	47	39.95	+ .14	17260.09	17292	59.72	.76	"	"	50.13
L.	4	46	56.17	+ .14	17216.31	17248	59.02	.69	"	"	49.36
R.	4	47	08.17	+ .14	17228.31	17260	58.92	.66	"	"	49.23
L.	4	47	06.19	+ .14	17226.33	17258	58.84	.63	"	"	49.12
R.	4	47	12.05	+ .14	17232.19	17264	59.48	.61	"	"	49.74
								Mean			86549.68
					Set 11. Face 2. October 6.						
L.	4	26	44.65	— .04	16004.61	16034	86558.66	+ .77	—11.89	—.01	86547.53
R.	4	26	42.44	— .04	16002.40	16032	59.80	.73	"	"	48.63
L.	4	26	38.69	— .04	15998.65	16028	58.48	.69	"	"	47.27
R.	4	26	30.53	— .04	15990.49	16020	59.46	.65	"	"	48.21
L.	4	24	18.62	— .04	15858.58	15888	60.28	.57	"	"	48.95
R.	4	24	20.45	— .04	15860.41	15890	61.16	.55	"	"	49.81
L.	4	23	54.63	— .04	15834.59	15864	60.48	.53	"	"	49.11
R.	4	24	02.64	— .04	15842.60	15872	60.36	.50	"	"	48.96
								Mean			86548.56

	Chronometer intervals.	Corr'n for rate.	Mean time intervals.	No. of vib'ns.	Corresp. No. in a day.	Corrections for arc.	temp.	atm. pr.	N.
					Set 12. Face 2. October 8.				
L.	4^h 08^m $14^s.45$	+ $^s.37$	$14894^s.82$	14922	86557.66	+1.00	—10.67	+.08	86548.07
R.	4 08 20.32	+ .37	14900.69	14928	58.34	.95	"	"	48.70
L.	4 08 12.25	+ .37	14892.62	14920	58.84	.91	"	"	49.16
R.	4 07 38.37	+ .37	14858.74	14886	58.50	.86	"	"	48.77
L.	4 07 10.38	+ .37	14830.75	14858	58.76	.81	"	"	48.98
R.	4 07 14.42	+ .37	14834.79	14862	58.48	.78	"	"	48.67
L.	4 06 54.53	+ .37	14814.90	14842	58.02	.75	"	"	48.18
R.	4 06 42.65	+ .37	14803.02	14830	57.48	.71	"	"	47.60
						Mean .	.	.	86548.52
					Set 13. Face 2. October 9.				
L.	4 12 23.89	+ .13	15144.02	15172	86559.62	+ .91	—10.35	+.11	86550.29
R.	4 12 21.89	+ .13	15142.02	15170	59.66	.86	"	"	50.28
L.	4 12 21.82	+ .13	15141.95	15170	60.08	.83	"	"	50.67
R.	4 12 25.67	+ .13	15145.80	15174	60.86	.76	"	"	51.38
L.	4 11 57.89	+ .13	15118.02	15146	59.92	.70	"	"	50.38
R.	4 12 05.97	+ .13	15126.10	15154	59.36	.67	"	"	49.79
L.	4 12 01.91	+ .13	15122.04	15150	59.76	.63	"	"	50.15
R.	4 12 05.92	+ .13	15126.05	15154	59.66	.60	"	"	50.02
						Mean .	.	.	86550.37
					Set 14. Face 4. October 10.				
L.	4 10 14.39	+ .21	15014.60	15042	86557.68	+ .66	—12.52	+.14	86545.96
R.	4 10 16.32	+ .21	15016.53	15044	58.04	.65	"	"	46.31
L.	4 10 16.13	+ .21	15016.34	15044	59.14	.62	"	"	47.38
R.	4 10 10.13	+ .21	15010.34	15038	59.22	.60	"	"	47.44
L.	4 09 44.14	+ .21	14984.35	15012	59.44	.55	"	"	47.61
R.	4 09 48.17	+ .21	14988.38	15016	59.22	.52	"	"	47.36
L.	4 07 50.37	+ .20	14870.57	14898	59.38	.45	"	"	47.45
R.	4 07 30.57	+ .20	14850.77	14878	58.44	.43	"	"	46.49
						Mean .	.	.	86547.00
					Set 15. Face 4. October 11.				
L.	4 09 47.75	— .25	14987.50	15016	86564.30	+ .82	—14.42	+.02	86550.72
R.	4 09 43.73	— .25	14983.48	15012	64.46	.78	"	"	50.84
L.	4 09 47.32	— .25	14987.07	15016	66.78	.74	"	"	53.12
R.	4 09 47.56	— .25	14987.31	15016	65.40	.68	"	"	51.68
L.	4 08 15.69	— .25	14895.44	14924	65.64	.62	"	"	51.86
R.	4 08 13.63	— .25	14893.38	14922	66.02	.59	"	"	52.21
L.	4 07 55.67	— .25	14875.42	14904	65.98	.57	"	"	52.15
R.	4 07 53.58	— .25	14873.33	14902	66.52	.55	"	"	52.67
						Mean .	.	.	86551.91

	Chronometer intervals.	Corr'n for rate.	Mean time intervals.	No. of vib'ns.	Corresp. No. in a day.	Corrections for arc.	temp.	atm. pr.	N.
				Set 16. Face 1. October 11.					
L.	$4^h\ 20^m\ 59^s.08$	$-{}^s.82$	$15658^s.26$	15688	86564.10	+ .79	−12.11	.00	86552.78
R.	4 21 00.82	− .82	15660.00	15690	65.50	.76	"	"	51.15
L.	4 21 09.04	− .82	15668.22	15698	64.20	.72	"	"	52.81
R.	4 21 06.96	− .82	15666.14	15696	64.68	.69	"	"	53.26
L.	4 20 37.02	− .82	15636.20	15666	64.66	.64	"	"	53.19
R.	4 20 37.02	− .82	15636.20	15666	64.66	.61	"	"	53.16
L.	4 20 35.10	− .82	15634.28	15664	64.22	.58	"	"	52.69
R.	4 20 39.00	− .82	15638.18	15668	64.76	.55	"	"	53.20
						Mean .	.	.	86553.15
				Set 17. Face 3. October 12.					
L.	4 23 09.35	− .88	15788.47	15818	86561.60	+ .67	−13.24	−.15	86548.88
R.	4 23 15.51	− .88	15794.63	15824	60.68	.64	"	"	48.93
L.	4 23 15.25	− .88	15794.37	15824	62.08	.61	"	"	49.30
R.	4 23 13.26	− .88	15792.38	15822	62.04	.59	"	"	49.24
L.	4 23 11.24	− .88	15790.36	15820	62.18	.55	"	"	49.34
R.	4 23 13.39	− .88	15792.51	15822	61.32	.53	"	"	48.46
L.	4 23 11.32	− .88	15790.44	15820	61.74	.52	"	"	48.87
R.	4 22 57.42	− .88	15776.54	15806	61.32	.50	"	"	48.43
						Mean .	.	.	86548.93

We therefore have the following resulting number of vibrations performed at Port Foulke in a mean solar day, the temperature of the pendulum being at 50° Fah., and the atmospheric pressure 29.8 inches (with the mercury at the temperature of freezing water).

First position of pendulum.		After reversal end for end.	
Face 4 swinging,	86550.17	Face 1 swinging,	86551.81
Face 2 "	86549.28	Face 3 swinging,	86551.18
Mean,	86549.72	Mean,	86551.50

Mean of two positions	86550.61
Correction for 40 feet elevation above half tide	+ 0.11
Resulting number of vibrations at the level of the sea in the latitude of Port Foulke	86550.72
The Port Foulke Observatory is in latitude	78° 17′ 39″

At Cambridge we have an excess of 2.68 vibrations in a day in the second position when compared with the first; at Port Foulke this excess is 1.78 vibration, from which numbers we infer that the pendulum has undergone no change.

Finally we have from the relation of $g : g_1 = N^2 : N_1^2$ force of gravity at Cambridge to force of gravity at Port Foulke as $(86419.64)^2$ to $(86550.72)^2$; however, if we reject the number of vibrations at Cambridge, face 4 swinging, as too small, since at Port Foulke the number for this position is quite accordant with the num-

bers of the remaining positions, we have to combine the mean of faces 1 and 3, or 86420.76 with face 2, or 86421.08, we find 86420.92, and adding the correction for elevation we have the proportion $g : g_1 = (86421.14)^2 . (86550.72)^2$.

Bearing of Preceding Pendulum Experiments on the Value for the Earth's Compression.—If there was no local disturbance in the force of gravity arising from irregular distribution and various densities of masses in the vicinity of the station, the observed number of vibrations at any two stations remote in latitude would suffice to deduce the earth's compression, and in proportion as we increase the number of pendulum stations the deduced value for the compression will gain in reliability, it being improbable that the local disturbances should all tend the same way. From two stations only we can obtain but a first approximation, thus from our observations

let N_1 = observed number of vibrations in a mean solar day in latitude ϕ_1
N_{11} = " " " " " " ϕ_{11}
N = number of vibrations in the same interval at the equator
n = a function of the earth's ellipticity

then the relation $N_0^2 = N^2\,(1 + n \sin^2\phi_0)$ furnishes the two equations

$$(86421.14)^2 = N^2\,(1 + n \sin^2 42^\circ\ 22'\ 51''.5)$$
$$(86550.72)^2 = N^2\,(1 + n \sin^2 78\ \ 17\ \ 39\ \ )$$

and solving these, we find for the *Hayes* pendulum $N = 86304.26$ and $n = 0.005965$. We have further by Clairaut's theorem

$$n = \frac{5}{2 \times 289} - c \qquad \text{whence } c = \frac{a - b}{b} \qquad \text{hence } c = \frac{1}{372}$$

a value very much smaller than that arising from the assemblage of the best pendulum results ($\frac{1}{285}$, Baily in Vol. VII, Mem. Roy. Ast. Soc.), but if combined with them would tend to diminish the value of c, and bring it nearer to that found from the geodetic measures ($\frac{1}{293}$ Lt. Col. James, Account of the Ordnance Trigonometrical Survey of Great Britain and Ireland, London, 1858). Values as small as that found above have, however, been observed before, see "an account of experiments for determining the variation in the length of the seconds pendulum at the principal stations of the trigonometrical survey of Great Britain. By Cap. H. Kater." Phil. Trans. Roy. Soc., 1819, Part 3, p. 423; also "Figure of the Earth," by G. B. Airy, Ast. Roy., Encyclopædia Metropolitana, 1830, p. 230. According to Baily's formula $V = (7441625711 + 38286335 \sin^2 L)^{\frac{1}{2}}$ we should have nearly 112 vibrations more at Port Foulke than at Cambridge, whereas by direct observation we have 131 nearly.[1]

Respecting the horizontality of the supporting plates of the Hayes' pendulum, the record at either station makes no mention, but as a deviation can easily be detected, I do not apprehend any source of error on this account. A special

[1] The maximum increase in the number of vibrations (in a day) of the seconds pendulum is about half the number of seconds in the maximum deflection of the plumbline (Capt. Clarke in Lt. Col. James' Ordnance Survey, pp. 590 and 594).

examination was made of the perpendicularity of the knife-edges to the longitudinal axis of the pendulum, also of their plane which should pass through the same axis —the test was found satisfactory. On this part of the theory of the physical pendulum, the paper "On the Pendulum," by J. W. Lubbock, Phil. Trans. Roy. Soc., 1830, Part 1, p. 201, may be consulted. There is reason to suppose that the support of the pendulum case at the stations was sufficiently massive to guard against induced vibrations. A fine mark on the supporting plate seems to have been used to secure an identical contact with the knife-edges; there are also two guiding pins to indicate the central position of the bar between the plates. The plates show no wear, and the knife-edges appear in perfect condition.

It is very desirable that the Hayes' pendulum be swung at a number of other stations[1] for the purpose of combining the results, and if possible to connect them with the accumulated series given by Baily. The connection could be made by swinging the pendulum at Captain Sabine's station of 1822–23 in New York City (or as near to it as possible, since the old site of the Columbia College is now inaccessible to such operations. Localities like Wash. on, D. C., and Key West, Florida, would be well suited for new observations, and if combined with any made at New York would furnish a valuable contribution to our present knowledge of the earth's compression as resulting from experiments of vibrations.

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[1] As pendulum observations have a direct bearing upon the larger geodetic operations for ascertaining the earth's figure, and have recently again been considered for introduction in the Russian and Indian arcs, I have taken occasion to bring the desirability of swinging the pendulum at some stations of the United States Coast Survey, to the favorable consideration of the Superintendent.

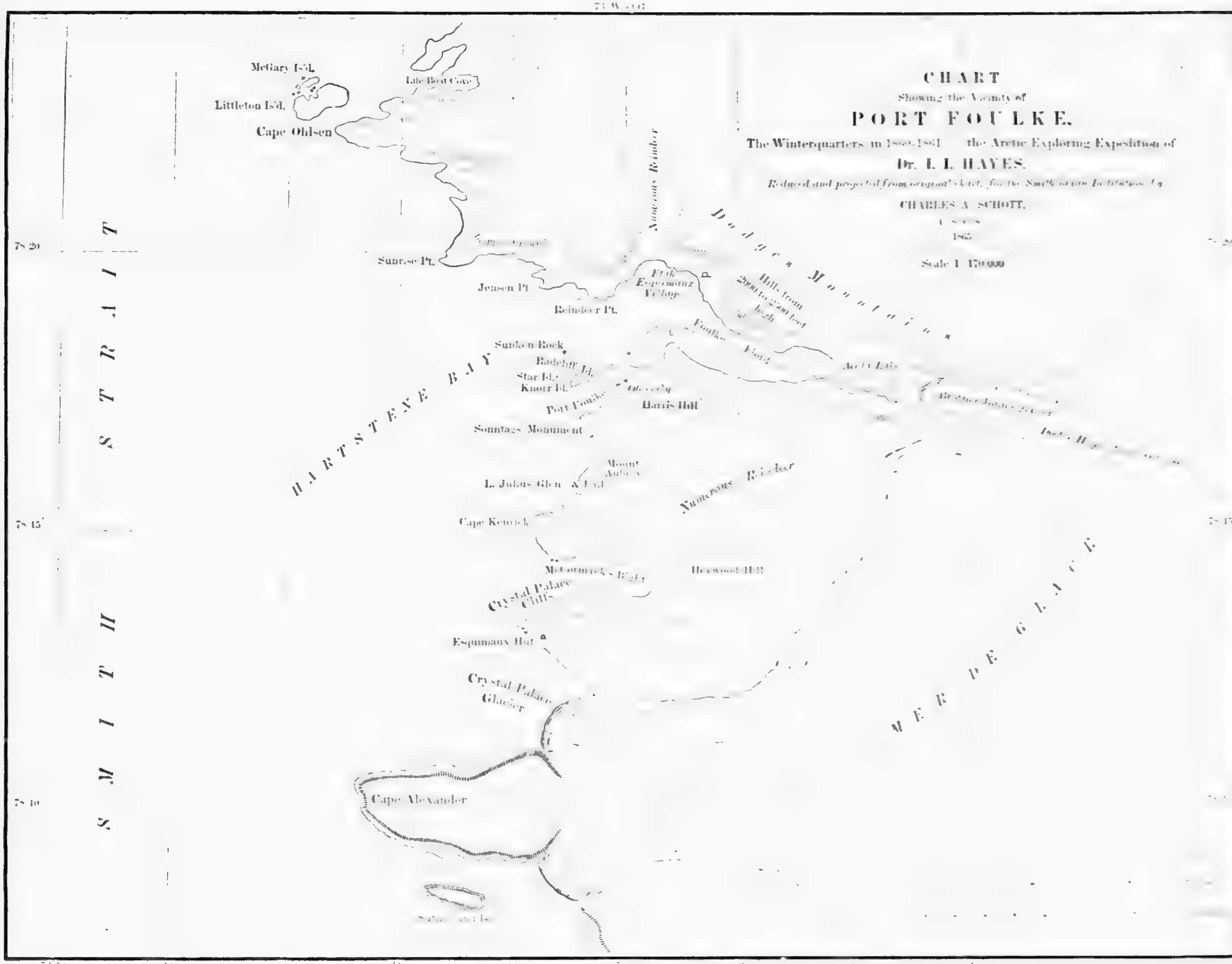
CHART
Showing the Vicinity of
PORT FOULKE.
The Winterquarters in 1860-1861 of the Arctic Exploring Expedition of
Dr. I. I. HAYES.
Reduced and projected from original sketch, for the Smithsonian Institution by
CHARLES A. SCHOTT.
1865
Scale 1 : 170,000
SMITH STRAIT
HARTSTENE BAY
Dodge's Mountains
MER DE GLACE
McGary Isd.
Littleton Isd.
Cape Ohlsen
Sunrise Pt.
Jensen Pt.
Reindeer Pt.
Etah Esquimaux Village
Hills from 2000 to 2500 feet high
Foulke Fiord
Sunken Rock
Star Id.
Knorr Id.
Port Foulke
Observy
Harris Hill
Sonntags Monument
Mount Auburn
Cape Kennedy
McCormick's Bight
Heywood Hill
Crystal Palace Cliffs
Esquimaux Hut
Crystal Palace Glacier
Cape Alexander
Numerous Reindeer
78 20
78 15
78 10
73 W. of G.
73 30

PART II.

MAGNETIC OBSERVATIONS.

RECORD AND RESULTS

OF

MAGNETIC OBSERVATIONS.

Introductory Remarks.—The present, second part, of the records and results of the Arctic Expedition of 1860 and 1861, commanded by Dr. Hayes, will contain the magnetic observations and their discussion.

These observations will be given under the heads "differential observations" and "absolute determinations. The former comprise a series of hourly readings of the declinometer on 15 days between November, 1860, and March, 1861, at Port Foulke, the winter quarters of the expedition; also three daily readings, for the same period, at stated hours. The latter class of observations includes many determinations of the declination, the dip, and the intensity of terrestrial magnetism at stations in the north of Greenland, on Smith Strait, and northward on Smith Sound. The declinations were chiefly determined by means of solar bearings, but there are also a few determinations with the declinometer.

The magnetometer (or declinometer) and dip circle, and a Smalkalder azimuth compass, used by the expedition, were furnished by the liberality of Prof. A. D. Bache, Superintendent United States Coast Survey. Besides these instruments, the expedition was provided with two small compasses and other ordinary ones; one small azimuth compass was loaned by the Bureau of Topographical Engineers.

Description of Instruments.—The magnetometer, made by W. H. Jones, of London, has an azimuth circle of six inches diameter, and can be read to 20″ by means of the verniers. The magnet is suspended in a box over the centre of the circle, the suspension tube is eight inches long. Two magnets, each three inches long and 0.3 inch in diameter, with mirror attached, are provided, also a collimater magnet $3\frac{1}{2}$ inches long, and but 0.3 inch of outer diameter. Ordinarily the ivory scale above the eye end of the telescope is used for reading the deflections when mirror magnets are suspended, for the determination of absolute declinations an extra telescope can be fastened to the projecting arm of the alidade, the collimater magnet is then suspended, the glass scale of which is illuminated by a small reflector. An inertia ring, thermometer, and other necessaries are also provided. The dip circle was made by Patton, of Washington, new needles have been supplied by Mr. Würdemann, they are about 8 inches in length. There are also two magnets for the reversals of the poles. A three legged stand accompanied these instruments.

For the instrumental constants, see determinations further on. Würdemann's prismatic azimuth compass reads from south through east to 360°; the other small compass reads from north to west.

The magnetic observations were commenced by Mr. A. Sonntag; after his death, in December, 1860, the care of the magnetic determinations devolved upon Mr. H. G. Radcliff, who was assisted by Messrs. C. C. Starr and G. F. Knorr, and also by the commander of the expedition.

The instrumental constants necessary for deducing the results for horizontal force and for scale value of the differential observations were made by me in Washington in June, 1862.

The geographical positions and chronometer corrections required in the discussion will be taken from the preceding astronomical paper (Part I of the scientific contributions by the expedition) without further special reference.

DIFFERENTIAL OBSERVATIONS AT PORT FOULKE.

These observations were made at the observatory (of which a general description has already been given); Dr. Hayes wrote to me the following note respecting the mounting of the instrument. "The magnetometer was mounted in the centre of the room upon a stand made of two kegs whose heads being removed, and the ends carefully fitted together, were filled with beans and water. These were of course soon frozen into a solid mass, and the lower keg being placed upon the solid rock through a hole cut in the floor, the support for the instrument was as firm as possible. No stove or other artificial means of warmth was at any time used."

Diurnal Variation of the Magnetic Declination.—For the purpose of investigating the diurnal march of the horizontal needle, hourly observations were recorded on 15 days, at Port Foulke, between November 26, 1860, and March 4, 1861. As the diurnal excursions of the magnet frequently exceed the range of the scale fastened to the telescope, the horizontal circle had to be shifted in order to bring the direction of the magnet at all times within central range of the telescopic scale; the record consists therefore of readings of the azimuth circle and of readings of the reflected scale. The observers are indicated by their initials, R. for Radcliff, K. for Knorr, and S. for Starr.

The instrument having been properly adjusted, the following readings were taken:—

Scale Readings of Declinometer.

Mean local time.	1860. Nov. 26–27.		Nov. 27.		Dec. 3–4.		Dec. 12–13.		Dec. 18–19.		Dec. 24–25.	
8 A.M.	$32^{d}.4$	R.	$28^{d}.3$	S.	$24^{d}.3$	R.	$35^{d}.4$	K.	$35^{d}.1$	K.	$34^{d}.2$	S.
9 "	25.3		28.2	R.	23.5		35.3		31.0		Inst. moved in cleaning	
10 "	30.9		26.5		26.1		35.2		33.8		38.3	
11 "	30.9		27.0		24.6		35.1		34.5		42.1	
Noon	35.8		28.9		25.5		35.1		33.7		44.2	
1 P.M.	35.0	K.	24.4	K.	25.2	K.	35.2	R.	34.3	R.	42.9	K.
2 "	34.8		25.1		25.9		35.5		33.3		43.0	
3 "	36.4		24.6		25.1		35.5		34.8		43.7	
4 "	36.5		26.4		25.9		35.0		34.3		44.1	
5 "	Inst't	S.			26.4	S.	35.2	K.	35.0	S.	44.5	R.
6 "	upset				25.1		35.1		34.5		44.6	
7 "	30.2				26.3		35.3		35.7		29.1	
8 "	31.1				27.3		35.5		36.0		29.4	
9 "	31.9	R.			27.5	R.	35.6	S.	36.2	K.	29.8	S.
10 "	31.7				27.5		35.7		36.9		29.9	
11 "	33.5				27.6		35.8		36.7		29.9	
Midn't	34.6				27.4		35.9		36.2		29.9	
1 A.M.	32.7	K.			27.8	S.	35.9	K.	35.8	S.	29.5	K.
2 "	33.2				27.9		35.9		35.0		29.3	
3 "	31.5				27.8		35.9		36.0		29.0	
4 "	32.3				27.7		35.9		37.0		30.2	
5 "	31.1	S.			27.3	K.	35.8	R.	36.2	R.	30.3	R.
6 "	29.4				27.6		35.6		35.1		30.4	
7 "	29.9				27.3		35.2		35.6		29.3	
8 "	28.3				27.2		35.2		35.1		28.4	

Corresponding Azimuth Circle Readings.

	8 A.M.	24° 40′	8 A.M.	33° 00′	8 A.M.	34° 20′	8 A.M.	33° 00′	8 A.M.	33° 00′	8 A.M.	33° 00′
	7 P.M.	33 00			10 "	34 50					10 "	25 00
											7 P.M.	29 00

Scale Readings.												
Mean local time.	1860. Dec.31. 1861. Jan. 1.		Jan'y 7-8.		Jan'y 14-15.		Jan'y 21-22.		Jan'y 28-29.		Feb'y 4-5.	
8 A.M.	$27^d.2$	R.	$28^d.1$	K.	$27^d.8$	S.	$32^d.0$	R.	$33^d.1$	K.	$33^d.8$	S.
9 "	27.2		28.1		28.3		29.7		33.0		33.9	
10 "	26.0		28.2		27.0		30 5		31.1		34.0	
11 "	26.1		28.3		27.5		30.6		31.5		34.0	
Noon	27.1		28.8		22.3		30.7		30.0		31.0	
1 P.M.	24.5	S.	27.9	R.	22.0	K.	31.8	S.	31.9	R.	32.4	K.
2 "	26.0		28.0		24.1		32.4		31.6		30.1	
3 "	23.9		27.7		24.5		32.7		34.4		29.8	
4 "	26.5		28.0		26.1		32.3		34.3		31.2	
5 "	27.8	K.	27.6	S.	24.9	R.	33.5	K.	34.6	S.	33.5	R.
6 "	28.3		27.7		27.0		34.0		34.7		34.1	
7 "	28.6		28.0		28.8		35.5		35.3		34.0	
8 "	29.1		28.4		28.6		35.6		35.0		34.9	
9 "	29.4	R.	29.3	K.	29.4	S.	36.2	R.	35.0	K.	35.4	S.
10 "	28.7		30.8		30.2		35.2		35.0		36.0	
11 "	28.7		30.5		29.5		35.3		35.0		35.5	
Midn't	29.3		30.8		30.4		35.3		35.4		34.9	
1 A.M.	29.0	S.	30.8	S.	30.4	K.	36.0	S.	34.7	R.	35.2	K.
2 "	29.1		30.4		30.1		37.0		34.8		36.1	
3 "	29.0		31.3		31.2		38.1		35.3		37.5	
4 "	28.4		29.6		29.1		38.0		35.0		36.4	
5 "	28.5	K.	30.6	R.	28.2	R.	37.6	K.	34.6	S.	36.5	R.
6 "	28.4		29.9		27.7		35.2		34.4		34.1	
7 "	28.1		28.9		27.5		33.7		34.4		34.2	
8 "	28.2		28.5		29.1		32.2		34.3		33.3	
Circle Readings.												
	8 A.M.	28° 00′	8 A.M.	28° 00′	8 A.M.	28° 00′	8 A.M.	27° 00′	8 A.M.	27° 00′	8 A.M.[1]	27° 00′

[1] Wind blowing from N. E. (true), and heavy snow drift during the observations.

Scale Readings.

Mean local time.	February 11-12.		February 18-19.		February 25.		March 4-5.	
8 A. M.	$34^d.3$	R.	$34^d.6$	K.	$36^d.8$	S.	$39^d.1$	R.
9 "	36.9		35.9		35.4		38.1	
10 "	36.7		36.5		35.1		37.7	
11 "	31.7		36.1		35.3		37.8	
Noon	37.3		Instrument moved		36.8		35.4	
1 P. M.	33.9	S	31.0	R.	37.0	K.	35.9	S.
2 "	35.8		30.1		38.3		35.1	
3 "	36.7		33.3		37.1		35.0	
4 "	35.1		35.8		35.8		35.2	
5 "	36.0	K.	35.1	S.	38.6	R	36.8	K.
6 "	38.6		35.2		38.5		38.1	
7 "	38.3		37.3		38.7		38.5	
8 "	39.0		37.8		38.8		38.0	
9 "	38.8	R.	37.9	K.	38.8	S.	39.3	R.
10 "	39.7		37.4		38.7		39.2	
11 "	39.3		38.6		38.6		38.9	
Midnight	41.6		40.3				39.5	
1 A. M.	43.1	S	37 2	R.			39.1	S.
2 "	39.9		36.6				39.3	
3 "	39.8		36.5				39.4	
4 "	36.6		36.7				38.5	
5 "	38.3	K.	37.0	S.			37.2	K.
6 "	38.0		36.2				38.1	
7 "	37.4		35.5				38.5	
8 "	35.9		33.0				38.8	•

Circle Readings.

	February 11-12.	February 18-19.	February 25.	March 4-5.
	8 A. M. 26° 20′	8 A. M. 26° 20′ 1 P. M. " "	8 A. M. 26° 20′	8 A. M. 26° 20′
	Light wind and snow from S. W. (true) until 8 P. M., when the wind blew stronger and snow drifting.	Calm and clear during the above observations.	Wind blowing heavy from N. (true), and snow drifting. Observations discontinued at 11 P. M. on account of wind.	Clear, with wind from N. E. (true) during the above observations.

We have now to express the preceding numbers in units of the same scale, and to refer them to the same zero for each day. The determination of the scale value at Washington gave 1 division $= 10'.14$ since in the present record the last figure is noted as a decimal. The given reading of the circle is taken to refer to the centre of the reflected scale or to the division 30, the excess above 30 converted into parts of a degree, has been added to the circle reading and the defect below 30, after conversion, has been subtracted from the circle reading, the latter being expressed in degrees and fraction of a degree.

Increasing scale numbers correspond to an *easterly* movement of the north end of the magnet; *increasing* circle readings are likewise in the direction from north to *east*. The correction for torsion (for deviations beyond 30.0 divisions) has been rejected by the observer as too small to affect the results.

The observations on November 26 and 27, 1860, will be omitted in the following table owing to the break in the series on the 26th, and the incompleteness on the 27th.

The first two readings, December 24, 1860, require to be changed to conform to the readings of the day; these readings, after conversion, are 33°.71 and 33°.71; they have been changed into 27°.42 and 27°.42 by the following process of interpolation: If we compare the readings December 24 at 10^h, 11, 12, 1, 2, 3^h, with the readings at the same hours on the three days of observation preceding, we find the corrections —6.31, —6.47, —6.64 to be applied to the latter to produce the series on December 24, and applying these quantities to the readings at 9 A. M., we find for that hour, December 24, 26°.96. Again, the mean reading at 9 A. M., before the break from 5 observations, is 33.34, and from 8 observations, after the break, 27.48, difference —5.86; and applying this to the actual reading December 24, 9 A. M., we find the value 27.85; the mean of these two values is 27.40. By the same process for 8 A. M., we find 27.44, the mean 27.42 is given in the table. The break in the series amounted therefore to 6°.29,

The value for noon, February 18, is the mean of the values for 11 P. M. and 1 P. M.; the instrument does not appear to have been permanently disturbed. The incomplete readings of February 25th are omitted.

Hourly readings of the declinometer at Port Foulke, expressed in degrees and fraction; increasing numbers denote a movement of the north end of the magnet towards the east.

1860 1861	Dec. 3–4.	Dec. 12–13.	Dec. 18–19.	Dec. 24–25.	Dec. 31 Jan. 1.	Jan. 7–8.	Jan. 14–15.	Jan. 21–22.	Jan. 28–29.	Feb. 4–5.	Feb. 11–12.	Feb. 18–19.	March 4–5.
8 A.M.	33.°37	33°.91	33°.86	27°.42	27°.53	27°.68	27°.63	27°.34	27°.53	27°.64	27°.06	27°.11	27°.88
9 "	33.24	33.89	33.17	27.42	27.53	27.68	27.71	26.95	27.51	27 66	27.49	27.32	27.70
10 "	34.17	33.87	33.64	26.73	27.32	27.70	27.49	27.08	27.19	27.68	27.46	27.42	27.63
11 "	33.92	33.86	33.76	27.38	27.34	27.71	27.58	27.10	27.25	27.68	26.62	27.36	27.65
Noon	34.07	33.86	33.63	27.72	27.51	27.80	26.70	27.12	27.00	27.17	27.56	26.93	27.24
1 "	34.02	33.87	33.73	27.51	27.08	27.64	26.65	27.30	27.32	27.41	26.99	26.50	27.32
2 "	34.13	33.92	33.56	27.52	27.32	27.66	27.01	27.41	27.27	27.02	27.30	26.35	27.19
3 "	34.00	33.92	38.81	27.64	26.97	27.61	27.08	27.46	27.75	26.97	27.46	26.89	27.17
4 "	34.13	33.84	33 73	27.71	27.41	27.66	27.34	27.39	27.73	27.21	27.19	27.30	27.21
5 "	34.22	33.87	33.84	27.78	27.63	27.59	27.14	27.59	27.78	27.59	27.34	27 19	27.47
6 "	34.00	33.86	33.76	27.80	27.71	27.61	27.49	27.68	27.80	27.70	27.78	27.21	27.70
7 "	34.20	33.89	33.96	27.85	27.76	27.66	27.80	27.92	27.89	27.68	27.73	27.56	27.76
8 "	34.37	33.92	34.01	27.90	27.85	27.73	27.76	27.94	27.84	27.83	27.86	27.64	27.68
9 "	34.41	33.94	34.04	27.97	27.90	27.88	27.90	28.04	27.84	27.91	27.81	27.66	27.91
10 "	34.41	33.96	34.16	27.98	27.78	28.13	28.03	27.87	27.84	28.01	27.98	27.58	27.89
11 "	34.42	33.97	34.13	27.97	27.78	28.08	27.92	27.89	27.84	27.92	27.91	27.78	27.83
Midn't	34 39	33.99	34.04	27.98	27.88	28.13	28.07	27.89	27.91	27.83	28.29	28.07	27.94
1 "	34.46	33.99	33.97	27.92	27.83	28 13	28.07	28.01	27.80	27.87	28.54	27.54	27.88
2 "	34.47	33.99	33.84	27.88	27.85	28.07	28.02	28.18	27.81	28.03	28 01	27.44	27.91
3 "	34.46	33.99	34.01	27.83	27 83	28.22	28.20	28.37	27.89	28.26	27.99	27.42	27.93
4 "	34.44	33.99	34.18	28.03	27.73	27.93	27.85	28.35	27.84	28.08	27.44	27.46	27.76
5 "	34.37	33.97	34.04	28.05	27.75	28.10	27.70	28.28	27.78	28.09	27.73	27.51	27.51
6 "	34.42	33.94	33.86	28.07	27.73	27.98	27.61	27.87	27.75	27.70	27.68	27.37	27.70
7 "	34.37	33.87	33.94	27.88	27.68	27.82	27.58	27.63	27.75	27.72	27.58	27.25	27 76
8 "	34.36	33.87	33.86	27 68	27.70	27.75	27.85	27.37	27.73	27.56	27.32	26.84	27.81

As the series is a short one, I give the separate means of 6 and of 7 days to compare with the mean of 13; these partial results confirm the general regularity of the diurnal variation, and show that we may place confidence in the result deduced from the aggregate values.

Diurnal Variation of the Magnetic Declination at Port Foulke, Smith Strait, December to March, 1860–61.

Mean local time.	Mean of 6 days.	Mean of 7 days.	Mean of 13 days.	Mean local time.	Mean of 6 days.	Mean of 7 days.	Mean of 13 days.
8 A. M.	30°.63	27°.46	28°.92	8 P. M.	30°.96	27°.79	29°.26
9	× 30.49	27.48	28.87	9	31.02	27.87	29.32
10	30.57	27.31	28.81	10	31.07	27.89	29.36
11	30.66	27.32	28.86	11	31.06	27.87	29.34
Noon	30.76	27.10	28.79	Midnight	‡ 31.07	28.00	‡ 29.42
1	30.64	× 27.07	× 28.72	1	31.05	27.96	29.38
2	30.68	27.08	28.74	2	31.02	27.92	29.35
3	30.66	24.25	28.83	3	31.06	‡ 28.01	‡ 29.42
4	30.75	24.34	28.91	4	31.05	27.83	29.31
5	30.82	27.44	29.00	5	31.05	27.80	29.30
6	30.79	27.62	29.08	6	31.00	27.67	29.21
7	30.89	27.76	29.20	7	30.93	27.61	29.14
				8	30.87	27.50	29.05

West elongations are indicated by a , and *east* elongations by ‡.

Taking the mean of the two values at 8 A. M., and subtracting each hourly value from the mean of the whole (29°.11), we obtain the diurnal variation as given in the following table; the values are given in minutes. For comparison I have added the diurnal variation observed at Van Rensselaer Harbor by Dr. Kane;[1] these results are given in two columns, the second one containing the variation after the omission of the larger disturbances. To separate in our series the disturbances from the regular readings would not lead to any satisfactory results, as the observations are much too limited in number; no very large disturbances, however, ar recorded, so that we may with equal advantage compare the Port Foulke results with others, including or excluding the larger disturbances. By the additional comparisons with Point Barrow,[2] Toronto, and Philadelphia,[3] we may be enabled to generalize certain features in the diurnal variation of the north-magnetic hemisphere. Van Rensselaer and Port Foulke are stations situated to the *northward* of the magnetic pole (of dip 90° and horizontal force 0).

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[1] See my discussion of Dr. Kane's Magnetic Observations in the Arctic Seas, in the Smithsonian Contributions to Knowledge, November, 1858.

[2] Phil. Trans. Royal Society, 1857, Part II, Art. xxiv. On hourly observations of the magnetic declination made by Captain R. Maguire, R. N., and the officers of H. M. S. Plover, in 1852–53–54, at Point Barrow. By Maj.-Gen. E. Sabine.

The comparison with Toronto is taken from the same paper.

[3] Smithsonian Contributions to Knowledge, June, 1862. Discussion of the Magnetic and Meteorological Observations made at the Girard College, Philadelphia, 1840 to 1845, Part II. By A. D. Bache, LL.D.

Comparative Table of Diurnal Variation of the Magnetic Declination observed at some stations situated to the northward, southward, eastward and westward of the Magnetic Pole.

West deflection from the normal position is indicated by a + sign, east deflection by a — sign. West elongations are indicated by a × affixed, east elongations by the sign ‡.

Mean local time.	Port Foulke. December to March, 1860–61.	Van Rensselaer Harbor. January to March, 1854.	Van Rensselaer Harbor. Same, omitting large disturbances.	Point Barrow. Omitting larger disturbances, 1852–54.	Toronto. Omitting larger disturbances.	Philadelphia. Winter months, 1841–45.	Philadelphia. Same, omitting large disturbances.
Midnight	—19′‡	—28′	—35′‡	+ 5′.3	—0′.6	—0′.6	—0′.4
1 A. M.	—16	—28	—27	+ 2.8	—0.5	—0.3	—0.3
2 "	—14	—29‡	—35‡	— 0.6	—0.5	—0.3	—0.3
3 "	—19‡	—28	—34	— 4.4	—0.7	—0.4	—0.4
4 "	—12	—28	—26	— 9.0	—1.1	—0.5	—0.5
5 "	—11	—23	—20	—11.4	—1.9	—0.6	—0.7
6 "	— 6	—10	— 8	—14.6	—3.0	—0.9	—1.1
7 "	— 2	+ 1	+ 9	—15.2‡	—4.0	—1.5	—1.7
8 "	+ 7	+12	+19	—12.7	—4.4‡	—2.0‡	—2.2‡
9 "	+14	+17	+23	— 8.2	—3.6	—2.0	—2.2
10 "	+18	+31	+30	— 3.8	—1.2	—1.0	—1.1
11 "	+15	+30	+29	+ 1.4	+1.7	+0.7	+0.6
Noon	+19	+38×	+29	+ 4.8	+4.0	+2.3	+2.2
1 P. M.	+23×	+35	+34×	+ 8.2×	+5.1×	+3.2×	+3.1×
2 "	+22	+26	+26	+ 7.5	+4.9	+3.2	+3.1
3 "	+17	+21	+14	+ 7.2	+3.8	+2.5	+2.4
4 "	+12	+ 7	+ 7	+ 7.2	+2.5	+1.6	+1.5
5 "	+ 7	+24	+24	+ 7.0	+1.3	+0.8	+0.8
6 "	+ 2	+12	+ 6	+ 6.7	+0.5	+0.4	+0.4
7 "	— 5	— 3	— 4	+ 4.4	—0.1	—0.3	—0.1
8 "	— 9	—13	— 9	+ 3.8	—0.2	—1.0	—0.5
9 "	—13	—21	—16	+ 3.9	—0.5	—1.4	—0.9
10 "	—15	—21	—13	+ 4.4	—0.7	—1.4	—0.9
11 "	—14	—22	—22	+ 5.2	—0.7	—1.0	—0.7
	Northward and Eastward.			Westward.	Southward of magnetic pole.		

The geographical position and declination of these stations are as follows:—

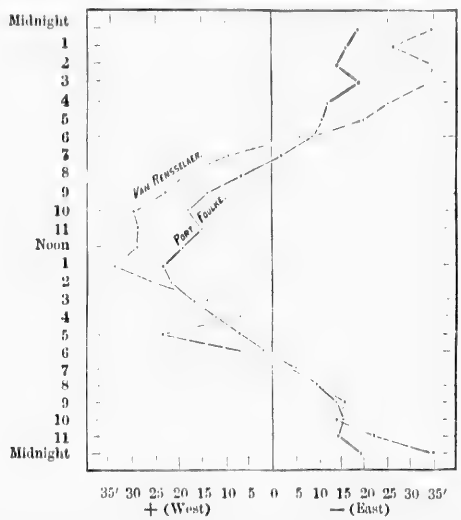
Port Foulke . .	φ = 78° 18′	λ = 73° 00′	D = 111° 40′ W.	1861.5	
Van Rensselaer .	78 37	70 53	108 12 W.	1854.5	
Point Barrow . .	71 21	156 15	41 E.	1852–53–54	
Toronto	43 40	79 22	1 45 W.	1853.5	Third Vol. of Toronto Obs. Lond., 1857.
Philadelphia . .	39 58	75 10	3 32 W.	1841–1845	Part XII of Discussion of Gir. Col. Mag. (May, 1864).
Magnetic pole according to Ross	70 05	96 46	- - - - - - -	observed 1831	Phil. Trans., 1834, Vol. I, Art. III.
Magnetic pole according to Evans	70 00	97 00	- - - - - - -	constructed 1858	Map of isogonic lines.

Comparing the Port Foulke and Van Rensselaer Harbor diurnal progression, we notice a close correspondence, viz: a maximum *west* deflection about 1 P. M.; a maximum *east* deflection between 2 and 3 A. M.; a normal position of the needle about 6½ P. M. and 7 A. M.; in fact the only noticeable difference is a less range

of motion at Port Foulke (42′) when compared with that of Van Rensselaer (69′); this may be due to the short series of observations at either place, and partly also to disturbances. The horizontal force at Port Foulke being smaller than at Van Rensselaer, and the former station having been occupied during a maximum of the ten or eleven year inequality, the latter during a minimum of that cycle, we should have expected the greater range at Port Foulke.

The two diurnal curves are further illustrated by means of the accompanying diagram.

Diurnal Variation in Winter.



Comparing the diurnal progression of the several stations, we find them to exhibit the maximum west deflection about 1 P. M., which, I believe, holds good for all places in the north magnetic hemisphere. It has also lately been observed, quite close to the magnetic pole, by Sir Francis L. McClintock[1] at Port Kennedy, in latitude 72° 01′, and in longitude 94° 19′ west, magnetic declination 135° 47′ west (1858–59). At the Whalefish Islands (Boat Island $\phi = 68° 59'$, $\lambda = 53° 15'$) near Godhaven, Lieut. Foster[2] found, in June, 1824, the maximum west deflection about 1¼ P. M. The morning maximum east deflection appears to be subject to certain fluctuations, but it keeps within the limits of midnight and 9 A. M.; its epochal variation is mostly due to the interferences of the disturbances which, for

[1] Phil. Trans. Roy. Soc., 1863, Part II. Results of hourly observations of the magnetic declination made by Sir Francis L. McClintock and the officers of the yacht "Fox," at Port Kennedy, in the Arctic Sea in the winter of 1858–59, etc. By Maj.-Gen. E. Sabine.

[2] Phil. Trans. Roy. Soc. 1826, Part IV. Observations on the diurnal variation of the magnetic needle at the Whalefish Islands, by Lieut. H. Foster, June, 1824.

11 June, 1865.

stations near the pole, may reach magnitudes sufficient even to overpower the regular solar diurnal progression.

It will be observed that at Port Foulke the motion of the north end of the needle from early morning till about one hour after noon, is westerly, magnetically, though in reality it is easterly, as the needle points *south* of west.

For the sake of illustration we will suppose an observer stationed at the magnetic pole near King William Island, and two needles placed in his meridian, one north the other south of him, also two needles placed in his parallel, one east the other west; these needles will point with their north or marked end towards him when in their normal position (which, for instance, always happens some hours before noon), but early in the morning, upon turning successively to them he will find them all deviating to his left, and an hour or two after noon he will find them deflected to his right; they have all moved in the interval from left to right, though in reality the marked end of the northern needle moved from west to east, that of the southern needle from east to west, and that of the eastern from north to south, and of the western from south to north; however, the motion of the eastern needle appears earlier, and that of the western later, by the amount of their difference of longitude with that of the observers, the motion being governed everywhere by local solar time.

The declinometer was also observed nearly every day at 8 A. M. and 2 and 10 P. M., between November 12, 1860, and March 9, 1861. There are, however, several interruptions, and the instrument has been moved in the interval. The only use I propose to make of this series is to ascertain the angular motion of the magnet between 2 and 10 P. M., and to form from it an estimate of the diurnal range.

Declinometer Record at Port Foulke. Scale Readings.

1860.	2 P. M.	10 P.M.	1860.	2 P. M.	10 P.M.	1860.	2 P. M.	10 P.M.	1861.	2 P. M.	10 P.M
Nov. 12	38.8	40.0	Dec. 21	33.5	36.3	Jan. 16	28.5	35.8	Feb. 10	29.3	46.0
13	39.2	40.5	22	33.4	35.8	Circle	28° 0′	27° 0′	11	35.8	39.7
14	37.2	43.2	23	34.1	38.0	17	32.1	34.6	12	30.7	42.1
15	37.8	46.2	24	43.0	29.9	18	33.8	36.5	13	36.9	39.3
16	39.0	42.9	Circle	25° 20′	28° 00′	19	33.7	35.2	14	35.9	39.7
17	36.4	44.1	25	18.0	29.4	20	28.4	34.6	15	31.8	38.9
18	41.5	42.0	26	26.1	29.3	21	32.4	35.2	16	31.9	39.7
22	42.0	42.4	27	25.1	29.4	22	39.9	35.5	17	34.2	29.8
23	37.2	46.5	28	25.4	29.7	Circle	23° 0′	27° 0′	18	30.1	37.4
24	43.1	46.5	29	28.8	28.7	23	25.0	36.7	19	35.8	37.1
25	27.9	36.5	30	28.4	29.2	24	14.8	37.5	20	36.3	36.7
Dec. 1	43.3	44.3	31	26.0	28 7	25	11.3	39.9	21	26.7	35.1
3	25.9	27.5	1861			26	17.3	39.0	22	33.8	41.3
4	26.2	27.7	Jan. 2	26.1	34.2	27	28.0	35.9	23	29.8	38.9
5	24.7	27.4	3	28.4	30.8	28	31.6	35.0	24	33.2	39.2
9	33.2	38.3	4	22.7	30.3	29	33.2	37.4	25	53.3	38.7
10	25.6	42.1	5	27.1	30.6	30	34.1	34.9	26	38.5	38.7
11	34.6	36.0	6	15.2	29.0	31	33.6	37.0	27	27.8	38.9
12	35.5	35.7	7	28.0	30.8	Feb. 1	32.8	29.5	28	26.6	38.5
13	35.6	35.7	8	28.5	29.3	2	28.4	36.0	March 1	30.0	24.6
14	34.0	35.6	9	28.7	30.8	3	33.1	35.4	2	35.5	29.9
15	35.6	24.4	10	29.0	29.6	4	30.1	36.0	3	36.9	38.6
16	25.1	35.8	11	27.7	30.8	5	32.4	35.0	4	35.1	39.2
17	34.0	34.3	12	26.3	28.5	6	33.0	35.3	5	38.3	38.9
18	33.3	36.9	13	28.6	29.8	7	34.4	35 6	6	37.6	39.8
19	31.7	38.8	14	24.1	30.2	8	34.3	34.7	7	36.1	39.2
20	30.5	36.2	15	28.6	29.3	9	34.5	34.9	8	38.5	39.0

In the above record I have given the circle reading in those cases only when the circle had been shifted between the two hours of record, its reading from day to day being otherwise of no consequence. If we take the difference each day of the tabular numbers, we find, from 104 days, the average difference 4.42 divisions, or 45′, by which quantity the north end of the needle moved easterly between 2 and 10 P. M. By the preceding diurnal curve we must add 1′ before 2 P. M., and add 4′ after 10 P. M. in order to get to the extreme range, which is therefore 50′, a value preferable to that given before.

At Philadelphia the ratio of the diurnal range in winter, to that of the whole year, is as 5.6 to 7.9, hence applying the same ratio to Port Foulke, we find the probable diurnal amplitude of the declination, on the average throughout the year and for an epoch of its greatest value in the ten or eleven year cycle, to be 1° 10′.

ABSOLUTE DETERMINATIONS.

Observations and Results of Magnetic Declinations.

The declination observations made in connection with the survey of the west coast of Smith Sound and Kennedy Channel, in the spring of 1861, will be given first, next those observed in Smith Strait, and last those determined in North Greenland. There are 14 stations in all.

An approximate correction for diurnal variation was applied to refer the observed declination to the mean declination of the day; this correction was derived from the mean diurnal progression as found at Port Foulke and Van Rensselaer Harbor.

Cairn Point, SMITH STRAIT.

Observations of magnetic declination, April 9, 1861. S. J. McCormick, observer.

Double altitudes and bearing of the sun.

Sextant: 2☉			
	25° 14′	Latitude, $\phi = 68° 30'.8$	$\cos t = \frac{\sin h - \sin \phi \sin \delta}{\cos \phi \cos \delta}$
	25 02	Longitude, $\lambda = 4^h 51^m 56^s$	
	24 53		
Mean,	25 03	☉'s decl'n, $\delta = 7° 49' 15''$	Put $tg\, M = \frac{tg\, \delta}{\cos t}$
Index correction,	+ 1	Hour angle, $t = 4^h 15^m 14^s$	then $\cos A = \frac{tg\, h}{cotg\, (\phi - M)}$
	12 32		
Refraction—par.,	— 4	$M = 17° 17' 11''$	
Semi-diameter,	+ 16	Azimuth, A $= 65° 42'$	
Observed altitude, h.	12 44	☉ Mag. bearing S. 176 00 W.	
		Mag. decl'n, + 110 08 at $4\frac{1}{2}^h$	

Observation of magnetic declination, April 12, 1861. S. J. McCormick, observer.

Bearing of the sun at noon . . . . . . N. 70° W.
Hence magnetic declination . . . . . + 110° 0′

Observations of Magnetic declination, April 15, 1861. I. I. Hayes, observer.

Bearing of the sun.

(Pock.) chron'r correction ΔT April 15		-7^m	51^s	Put $tg\,M = \frac{tg\,\delta}{\cos t}$
Observed time of ⏀	11^h	15	00	
Mean time of observation (14th) . .	23	07	09	then $tg\,A = \frac{tg\,t \cos M}{\sin(\phi - M)}$
Equation of time E		+1	13	
Hour angle t	−0	51	38	

$\delta = +\ 9°\ 55'\ 25''$

$M = 10\ \ 10\ \ 34$

$A = -\ 13\ \ 38$

⏀ Magnetic bearing, 262 15 (By Würdmann's compass, counting from S. through E.)

Magnetic decl'n, + 111 23

RECAPITULATION OF RESULTS.

1861.	Observed declination.	Time.	Approximate correction for diurnal variation.	Dec'n.
April 9	+ 110° 18′	4¼ P. M.	−25′	+ 109° 53′
" 12	+ 110 00	Noon	−28	+ 109 32
" 15	+ 111 23	11 A. M.	−22	+ 111 01
			Mean . . .	+ 110 09

Foggy Camp, SMITH SOUND.

Observations for magnetic declination, May 13 (P. M.) 1861. I. I. Hayes, observer.

Bearing of the sun.[1]

P. chron'r $\Delta T = +$	1^h	19^m	48^s	$\phi = 79°\ 55'.5$
Observed time |⊙	4	17	20	$\lambda = 4^h\ 45^m\ 52^s$
Mean time of ob's,	5	37	08	
E +		3	53	⊙'s $\delta = 18°\ 33'\ 25''$
t	5	41	01	$M = 76\ \ 09.3$

$A = 88\ \ 41.6$

Magnetic bearing |⊙ — 16′ 164 14.0

Magnetic declination, + 107 04.4 or + 106° 53′ when corrected for diurnal var'n.

Camp Hawks, SMITH SOUND.

(Two miles from Irving Island, Dobbin Bay.)

Observations for magnetic declination, May 22 (P. M.) 1861. I. I. Hayes, observer.

Bearing of the sun.[2]

P. chron'r $\Delta T = +$	1^h	14^m	32^s	$\phi = 79°\ 43'.7$
Observed time ⏀	8	02	50	$\lambda = 4^h\ 52^m\ 24^s$
Mean time of ob's,	9	17	22	
E		+3	34	⊙'s $\delta = 20°\ 33'\ 15''$
t	9	20	56	$M = -26\ \ 00.2$

$A = 142\ \ 09.0$

Magnetic bearing ⏀ 102 30.0

Magnetic declination, + 115 21.0 or + 115° 38′ when corrected for diurnal var'n.

---

[1] Another observation ⊙| 168° 25′ at $4^h\ 15^m\ 58^s$ has been rejected.

[2] Of the following observation I have made no further use: At $7^h\ 28^m\ 45^s$ angle between sun ⏀ and East Cape, Irving Island, 76° 8′, magnetic bearing of Cape 43° 15′. Computing from these data we have azimuth of Cape 30° 10′ east of north, and magnetic declination + 106° 35′.

Cache, on old Floe, Smith Sound.

Observations for magnetic declination, May 23 (A. M.) 1861. I. I. Hayes, observer.

Bearings of the sun.[1]

Pocket chronometer, May 30, Port Foulke, $\Delta T =$	+	1^h	12^m	17^s
$\delta T = -2^s.5$,	+			17
May 23, Port Foulke, $\Delta T =$	+	1	12	34
Difference of longitude,	+			28
ΔT Cache,	+	1	13	02

At	$9^h\ 56^m\ 30^s$	sun ⌽ bears		$65°\ 22'$	$\phi = 79°\ 30'$
"	10 13 27	"	"	75 30	$\lambda = 4^h\ 51^m\ 32^s$
"	10 15 07	"	"	76 35	
"	10 19 06	"	"	76 15	$\delta_1 = 20°\ 45'\ 27$
Mean	10 15 53	"	"	76 07	$\delta_{11} = 20\ 45\ 37$

P. chron'r, ΔT	$+ 1^h\ 13^m\ 02^s$	$+ 1^h\ 13^m\ 02^s$	$M_1 = -\ 21°\ 09'\ 55''$	$M_{11} = -\ 20°\ 53'\ 56''$
Observed time,	9 56 30	10 15 53	$A_1 =$ 168 50.3	$A_{11} =$ 173 26.6
Mean time of ob's,	11 09 32	11 28 55	$B_1 =$ 65 22.0	$B_{11} =$ 76 07.0
E	+ 3 29	+ 3 29	Mag. decl'n, = + 125 47.7	Mag. decl'n, = + 110 26.4
t	11 13 01	11 32 24	Weight 1	Weight 3

Magnetic declination, = + 114° 17′ or 113° 52′ when corrected for diurnal variation.

Scouse Camp, Smith Sound.

Observations for Magnetic declination, May 23 (24th, midnight), 1861. I. I. Hayes, observer.

Bearing of the sun.

Pocket chronometer ΔT	$+ 1^h\ 13\ 02$	$\phi = 79°\ 29'$	
Observed time ⌽	0 40 00	$\lambda = 4^h\ 51^m\ 32^s$	
Mean time of obser'n (23d),	13 53 02	$\delta =$	$20°\ 46'\ 42$
E	+ 3 29	$M = -$	23 28.7
t	13 56 31	$A =$	207 40.5
Magnetic bearing of ⌽			40 35.0
Magnetic declination,			+ 111 44.5 or + 112° 06′ when cor'd for diur'l var'n.

Potato Camp, Smith Sound.

Observations for magnetic declination, May 24 (P. M.), 1861. I. I. Hayes, observer.

Bearing of the sun.

P. chr. May 30, Port Foulke $\Delta T =$	+	$1^h\ 12^m\ 17^s$	$\phi =$	$79°\ 04$	
$\delta T = -2^s.5$	+	14	$\lambda =$	$4^h\ 50^m$	
May 24, Port Foulke ΔT	+	1 12 31			
Difference of longitude,	+	2 00	$\delta =$	$20°\ 54'\ 57''$	
ΔT Potato Camp,	+	1 14 31	$M = -$	39 9.8	
Observed time ⌽		6 34 00	$A =$	121 07.4	
Mean time of observation,		7 48 31	⌽ mag.	133 30.0	
E	+	3 25	Mag. decl'n, +	105 23	or 105° 34′ when corrected for diur'l var'n.
t		7 51 56			

[1] An observation at Small berg Camp, on the morning of the same date, was found erroneously recorded, and has therefore been omitted.

Camp Separation, SMITH SOUND.

Observations for magnetic declination, May 24 (25th A. M.), 1861. I. I. Hayes, observer.

Bearing of the sun.

P. chr. May 25, Port Foulke $\Delta T =$	$+ 1^h$	12^m	30^s	$\phi =$	78° 53′
Difference of longitude,	+	3	32	$\lambda =$	$4^h\ 48\frac{1}{2}^m$
T Camp Separation,	+ 1	16	02		
Observed time,	12	58	00	$\delta =$	20° 57′ 45″
Mean time of obs'tion (24th),	14	14	02	$M =$	— 24 53.6
E	+	3	24	$A =$	212 33
	14	17	26	Bearing ☉	42 45

Magnetic declination, + 104 42 or + 105° 04′ when corrected for diurnal variation.

Last Camp, SMITH SOUND.

Observations for magnetic declination, May 26 (P. M.), 1861. I. I. Hayes, observer.

Bearing of the sun.

P. chr. May 26, Port Foulke, $\Delta T =$	$+ 1^h$	12^m	26^s	$\phi =$	78° 38′
Difference of longitude,	+	3	32	$\lambda =$	$4^h\ 48\frac{1}{2}^m$
ΔT Last Camp,	+ 1	15	58		
Observed time ☉	5	47	30	$\delta =$	21° 15′ 36″
Mean time of observation,	7	03	28	$M =$	— 53 36.7
E	+	3	13	$A =$	110 28.8
	7	06	41	Mag. bearing ☉	141 00

Magnetic declination, + 108 31 or + 108° 36′ when corrected for diurnal var'n.

Starr Island, PORT FOULKE, SMITH STRAIT.

October 27, 1860. August Sonntag, observer.

By means of the observed bearing of the base line and the agreement of the observed and computed latitude of Cape Isabella (see astronomical part) we have the magnetic declination + 109° 45′

$\phi = 78° 17'.8$ $\lambda = 73° 06'.0$

Northumberland Island, OFF SOUTH SIDE, WHALE SOUND. August 3, 1861.

The record of this observation not being quite complete, the observer's result, or + 106° 00′, is adopted.

$\phi = 77° 11'$ $\lambda = 72° 20'$

Netlik, WHALE SOUND.

(For result by declinometer see further on.)

Observations of magnetic declination, August 4 (5th A. M.), 1861. S. J. McCormick, observer.

Bearing of the sun.

Observed time, pocket chronometer,	2^h	20^m	44^s		
Chronometer correction ΔT	-4	41	54	$\phi =$	$77°\ 07'.8$
Mean time of observation (4th),	21	38	50	$\gamma =$	$4^h\ 45^m\ 28^s$
Equation of time E	$-$	5	41	$\delta =$	$16°\ 54'\ 21''$
Hour angle t	-2	26	51	$M =$	20 45.8
				$A =$	-39 57

ϕ magnetic bearing, S. 68 00 W.

Magnetic declination, + 107 57 or + 107° 37′ when corrected for diurnal variation.

For a second determination see further on.

Port Foulke, SMITH STRAIT, July, 1861.

Observations for magnetic declination at the Observatory. H. G. Radcliff, observer.

Instruments used: Portable declinometer and theodolite.

Observations for azimuth of marks B and C. July 9 P. M., 1861.

The horizontal circle of the theodolite reads in a direction from south towards east.

Bearings of the sun.

Mark or Limb.	Pocket chronometer.	Circle readings.		Mark or Limb.	Pocket chronometer.	Circle readings.	
⊙|	$6^h\ 03^m\ 39^s.5$	56° 56′.5	57′.5				
|⊙	6 06 45.0	57 18	19				
B		40 00	02	⊙|	$6^h\ 31^m\ 55^s$	49° 31′	31′.5
B		40 00	02	|⊙	32 45	49 56	55
C		167 25	24.5	B		40 05	05
⊙|	6 22 38	52 00	01.5	C		167 28.5	26.5
|⊙	6 24 07	52 14.5	15.5	⊙|	6 43 20	46 20.5	20
B		40 00.5	02	|⊙	6 44 36	46 37.0	36.5
C		167 24	24				

We have from the astronomical paper the chronometer correction of 2007 on mean time, July 9, 1861 = $-4^h\ 47^m\ 17^s$, and from the chronometer comparison, pocket chronometer, $2^h\ 03^m\ 35^s.8 = 2^h\ 3^m$ by chronometer 2007; hence $\Delta T =$ $-4^h\ 47^m\ 53^s$; we have also the observed times of the sun's centre, from the above: $6^h\ 05^m\ 12^s$, $6^h\ 23^m\ 22^s$, $6^h\ 32^m\ 20^s$, and $6^h\ 43^m\ 58^s$ by chronometer. The corresponding derived hour angles are $1^h\ 12^m\ 25^s$, $1^h\ 30^m\ 35^s$, $1^h\ 39^m\ 32^s$, and $1^h\ 51^m\ 10^s$, and the computed azimuths, 20° 08′.3, 25° 08′.5, 27° 35′.8, and 30° 46′.5 (all west of south); hence by means of the corresponding circle readings 57° 07′.7, 52° 07′.9, 49° 43′.4, and 46° 28.′5, in connection with the mean reading of B 40° 01′.6, and of C 167° 25′.4 we obtain the

Azimuth of B.	Azimuth of C.
37° 14′.9	37° 15′.2 azimuth of B
37 14.8	127 23.8 angular difference
37 17.6	
37 13.4	90 08.6 E. of S.
Mean, 37 15 2 W. of S.	

Set 1. Observations for declination, July 10, 1861.

The horizontal circle of the declinometer reads in the direction from south towards west. The pointing is upon the axis of the collimator.

Between 2^h and 3^h by chronometer, the collimator magnet read 134° 56′ 20″ and 134° 57′ 00″, and the azimuth mark B 284° 26′ 30″ and 26′ 30″, also C 156° 26′ 00″ and 26′ 40″. We have consequently at $9\frac{3}{4}^h$ A. M.

180° + collimator,	314°	56′.7		314°	56′.7
Mark B,	284	26.5	C,	156	26.3
	30	30.2		158	30.4
Azimuth of B, W. of N.	142	44.8	Azimuth of C,	270	08.6
Magnetic declination W.	112	14.6		111	38.2
			Mean, = +	111	56

Set 2. Observations for declination. July 11, 1861.

Between 8^h 35^m and 9^h 35^m by chronometer, the collimator magnet read 134° 56′ 0″ and 56′ 40″, and the azimuth mark B 284° 26′ 10″ and 26′ 40″, also C 156° 26′ 40″ and 26′ 40″. Hence for $4\frac{1}{4}^h$ P. M.

180° + collimator,	314°	56′.3		314°	56′.3
Mark B,	284	26.4	C,	156	26.7
	30	29.9		158	29.6
Azimuth B,	142	44.8	Azimuth C,	270	08.6
Magnetic declination W.	112	14.9		111	39.0
			Mean, = +	111	57

Correction for diurnal variation to set 1, — 22′, and to set 2, — 12 , hence corrected mean + 111° 40′.

Netlik, Whale Sound.

Observations with portable declinometer and theodolite. H. G. Radcliff, observer.

Observations for azimuth of mark A. August 4, P. M. 1861.

Bearings of the sun.							
Mark or Limb.	Pocket chronometer.	Circle.		Mark or Limb.	Pocket chronometer.	Circle.	
A		8° 34′	36′	⊙|	48^m 28^s	70° 50′	51′
⊙|	10^h 44^m 45^s	71 43	43	|⊙	50 41	70 50	51
|⊙	47 01	71 43	43	A		8 34	36

From the astronomical paper we have, for August 4 (P. M.), the pocket chronometer correction $\Delta T = -4^h\ 41^m\ 54^s$.

Observed times of the sun's centre 10^h 45^m 53^s and 10^h 49^m 35^s by chronometer. The corresponding computed hour angles are 5^h 58^m 14^s and 6^h 01^m 57^s, and the azimuths 93° 29′.2 and 94° 23′.3 (west of south); hence by means of the corresponding circle readings 71° 43′.0 and 70° 50′.5 in connection with the mean reading of the mark A 8° 35′ we obtain the azimuth of the mark.

156°	37′.2	
156	38.8	
156	38.0	W. of S.

OBSERVATION FOR DECLINATION. August 4 P. M

Between 10^h 35^m and 11^h 25^m by chronometer, the collimator magnet read 10° 37′ 00″ and 37′ 40″, and the azimuth mark 273° 42′ 20″ and 43′ 40″. We have—

180° + collimator,	190° 37′.3	
Mark A,	273 43.0	
	276 54.3	
Azimuth of mark W. of N.	23 22.0	
Magnetic declination W.	106 27.7	at $6\frac{1}{4}$ P. M. or + 106° 25′ when corrected for diur'l var'n

Combining this result with the first obtained by S. J. M'Cormick, and giving the weight 2 to Radcliff's determination, and the weight 1 to M'Cormick's, we find the resulting declination + 106° 49′.

Upernavik, NORTH GREENLAND. August 16 P. M., 1861.

Observations with portable declinometer and theodolite. H. G. Radcliff, observer.

Observations for azimuth of mark A.

Bearings of the sun.							
Mark or Limb.	Pocket chronometer.	Circle.		Mark or Limb.	Pocket chronometer.	Circle.	
A		266° 45′.5	47′	$\vert\odot$	10^h 42^m 05^s	145° 15′	14′
A		266 45	46	A		266 47	46
$\odot\vert$	10^h 27^m 42^s	148 06	05.5	$\odot\vert$	10 31 02	147 18	18
$\vert\odot$	10 29 55	148 05.5	05.5	$\vert\odot$	10 33 20	147 18	18
A		266 47	46	A		266 45	46
$\odot\vert$	10 39 51	145 15.5	14.5				

The astronomical paper furnishes $\Delta T = -3^h\ 41^m\ 52^s$ (sufficiently near for Aug. 16). We have the observed times of the sun's centre 10^h 28^m 48^s, 10^h 32^m 11^s, and 10^h 40^m 58^s, the corresponding computed hour angles 6^h 43^m 01^s, 6^h 46^m 24^s, and 6^h 55^m 11^s, also the computed azimuths of the sun 75° 44′.8, 74° 57′.0, and 72° 53′.0 (W. of N.); the corresponding circle readings are 148° 05′.6, 147° 18′.0, and 145° 14′.8; the mean reading of the mark A, 266° 46′.2 and its azimuth

$$\left.\begin{array}{l} 14^\circ\ 25'.4 \\ 14\ \ 25.2 \\ 14\ \ 24.4 \end{array}\right\}\ \text{Mean } 14^\circ\ 25'.0 \text{ E. of S.}$$

OBSERVATIONS FOR DECLINATION. August 17, A. M., 1861.

Between 2^h 0^m and 3^h 0^m by chronometer, the collimater magnet read 161° 13′ 30″ and 14′ 00″, and the azimuth mark A 219° 21′ 30″ and 22′ 00″; we find

180 + collimator,	341° 13′.7	
Mark A,	219 21.7	
	121 52.0	
Azimuth of mark W. of N.	194 25.0	
Magnetic declination W.	72 33.0	at 10^h 50^m A. M., correction for diurnal variation —21′

A result which appears to me rather doubtful, though not differing more than $2\frac{1}{2}$° from Captain Inglefield's determination in 1854, which was 75° W. The

diurnal variation and the disturbances in these high latitudes comprise so large a range as to require many and continued observations of the magnet. The result of the following observations, taken by Mr. Sonntag, at Pröven, accords well enough with the supposed distribution of magnetism as marked upon the Admiralty Chart of Baffin Bay of 1859 (No. 2177).

Pröven, North Greenland. August 8 (P. M.) 1860.
Instrument used: the theodolite. Observer, A. Sonntag.
Bearings of the sun.

Limb.	Pocket chronometer.	Circle.		Magnetic meridian.
$\odot\vert$	1h 20m 21s	29° 29′	30′	332° 02′
$\vert\odot$	1 21 24	29 49	50	03
$\vert\odot$	1 22 10	29 36	37	03
$\odot\vert$	1 22 50	28 50	50	02
$\vert\odot$	1 26 51	28 30	31	
$\odot\vert$	1 27 46	27 40	41	152 36.6
$\odot\vert$	1 28 35	27 26	27	35.6
$\vert\odot$	1 29 40	27 45	46	

We have from the astronomical paper the correction of the pocket chronometer, August 8, 1860, $\Delta T = +1^h\ 01^m\ 38^s$; the latitude $\phi = 72°\ 23'\ 01''$, and the longitude $\lambda = 3^h\ 42^m\ 11^s.1$. We find the hour angles $2^h\ 18^m\ 01^s$ and $2^h\ 24^m\ 33^s$ for the two sets, and the corresponding azimuths of the sun 39° 01′.5 and 40° 48′.0.

Magnetic meridian	152° 19′.3	152° 19′.3
Circle reading	29 26.3	27 50.8
Difference	122 53.0	124 28.5
Azimuth of sun	39 01.5	40 48.0
Magnetic declination W.	83 51.5	83 40.5

Mean declination + 83° 46′ or + 83° 24′ when corrected for diurnal variation.

Recapitulation of observed Declinations.
West (magnetic) declination is indicated by a + sign.

No.	Locality.	Latitude.	Longitude.	Declination.	Date.	Observer.
1	Pröven, North Greenland,	72° 23′	55° 33′	+ 83° 24′	Aug. 1860	A. Sonntag
2	Starr Island, Smith Strait,	78 18	73 06	+109 45	Oct. "	"
3	Cairn Point, "	78 31	72 59	+110 09	Apr. 1861	I. I. Hayes and S. J. M'Cormick
4	Foggy Camp, Smith Sound	79 55	71 28	+106 53	May, "	I. I. Hayes
5	Camp Hawks, "	79 44	73 06	+115 38	" "	"
6	Cache on Floe, "	79 30	72 53	+113 52	" "	"
7	Secuse Camp, "	79 29	72 53	+112 06	" "	"
8	Potato Camp, "	79 04	72 30	+105 34	" "	"
9	Camp Separation, "	78 53	72 08	+105 04	" "	"
10	Last Camp "	78 38	72 08	+108 36	" "	"
11	Port Foulke, Smith Strait,	78 18	73 00	+111 40	July "	H. G. Radcliff
12	Northumberland Island, Whale Sound,	77 11	72 20	+106 00	Aug. "	- - - - - - -
13	Netlik, "	77 08	71 22	+106 49	" "	H. G. Radcliff & S. J. M'Cormick
14	Upernavik, N. Greenland,	72 47	56 03	+ 72 12	" "	H. G. Radcliff

On the accompanying chart of iso-magnetic lines in the vicinity of Smith Strait, the isogonic lines are shown by full lines; they depend upon eleven observed declinations, those at Camp Separation and Potato Camp were excluded on account of instrumental defect and discordance, and Kane's determination at Van Rensselaer Harbor ($D = 108° 12'$ W., June, 1854, latitude $78° 37'$, longitude $70° 53'$) was admitted without correction for secular change, which is at present too imperfectly known and is certainly less than the errors to which the observations are liable.

The following simple expression for the distribution of the magnetic declination is sufficient for our case:—

$$D = D_\circ + x\Delta\phi + y\Delta\lambda \cos\phi$$

where

D = resulting declination, at adopted epoch in latitude ϕ, longitude λ
$D_\circ$ = mean declination at epoch, in mean latitude $\phi_\circ$ and mean longitude $\lambda_\circ$
$\Delta\phi = \phi - \phi_\circ$ and $\Delta\lambda = \lambda - \lambda_\circ$

These eleven observations give as many equations of conditions of the form $0 = D_\circ - D + x\Delta\phi + y\Delta\lambda \cos\phi$ from which x and y can be eliminated by the ordinary process.

We find $D_\circ = +109°.97$ $\phi_\circ = 78°.67$ $\lambda_\circ = 72°.37$

and $D = +109°.97 + 1.61\,\Delta\phi + 14.65\,\Delta\lambda \cos\phi$

by means of which equation the isogonic lines for 105°, 110°, and 115° have been located on the chart; the epoch is 1861.

The observations are represented as follows:—

	Observed D.	Computed D.	Difference.
Starr Island	+109°.75	+111°.57	—1°.82
Cairn Point	+110.15	+111.49	—1.34
Foggy Camp	+106.88	+109.64	—2.76
Camp Hawks	+115.63	+113 29	+2.34
Cache on Floe	+113.88	+112.63	+1.25
Scouse Camp	+112.10	+112.59	—0.49
Last Camp	+108.60	+109.18	—0.58
Port Foulke	+111.67	+111.27	+0.40
Northumberland Island	+106.00	+107.42	—1.42
Netlik	+106.82	+104.27	+2.55
Van Rensselaer Harbor	+108.20	+105.64	+2.56

Probable error of any single determination $\pm 1°.3$, and of any resulting line on chart $+ 0°.4$ nearly. These lines, when prolonged in one direction, must necessarily pass through the geographical pole, and in the other they extend to the magnetic pole.

MAGNETIC INTENSITIES.

Observations and Results.

WASHINGTON, D. C , June, 1862.

The following observations were made by myself at Washington, D. C., for the purpose of determining certain instrumental constants required for the reduction of the intensity observations made by the expedition.

The instrument was received here in May, 1862; it had not been used since its return from Greenland.

Determination of Moment of Inertia of Ring C.

Dimensions: Outer diameter, 2.335 inches } Temperature, 81° Fah.
Inner " 1.812 " }
Weight, 572.62 grains

Moment of inertia $K_1 = \frac{1}{2}(r^2 + r_1^2)\,w$. Where r and r_1 (in feet) equal outer and inner radius and w the weight, we find

$\log k_1 = 0.63771$ at 81° Fah.
$\log k_1 = 0.63775$ at 85 "

the linear expansion being 0.0000105 parts for each degree; the thickness of the ring is 0.147 inch; it is of bronze.

Determination of Moment of Inertia of Magnet Z 6 and its Appendages.

Station, Coast Survey Office, Washington, D. C., June 13, 1862. Determination of value of one division of scale on telescope.

Azimuth circle.		Scale divisions.	
5° 17′ 20″	18′ 20″	300.8	295.2
9 16 20	17 00	59.5	64.1
0 33 40	34 40	579.0	575.5
5 15 10	16 00	301.7	298.4

Forming the differences we have $17° 22' 45'' = 1028.8$ divisions or 1 division $= 1'.014$

The azimuth circle reads in the direction from S. towards W., and an increase of scale reading (on telescope) corresponds to an east movement of the north end of the magnet.

Change of magnetic moment of deflecting magnet (Z 6) for 1° of temperature, $q = 0.0002$.

EXPERIMENTS OF VIBRATION. SET 1.

Magnet Z 6 suspended. Chronometer Kessels 1247, fast of mean time $2^h\ 32^m$, gains daily 6^s.

Charles A. Schott, observer.

No. of vibrations.	Time.	Temperature.	Extreme scale readings.	300 vib'ns at 84°.0.
0	$2^h\ 37^m\ 49^s.0$	85° Fah	359 and 241	
20	38 57.7			
40	40 06.6			
60	41 16.1			
80	42 24.7			
100	43 33.6			
200	49 18.9			
300	55 03.7			$17^m\ 14^s.7$
320	56 12.6			14.9
340	57 22.0			15.4
360	58 31.0			14.9
380	50 40.1			15.4
400	3 00 49.1	83.0	319 and 277	15.5
			Mean	17 15.13

Coefficient of torsion.

Tors. circle.	Scale.		Differences.
177°	301.6 and 295.2		
			2.6
267	299	303	
			4.5
87	300	293	
			1.4
177	301	294.8	

Mean (of 4) . . . 2.13 = 2′.15

Observed time of 300 vib'ns,	1035ˢ.13
Time of one vibration,	3.4504
Correction for rate,	—0.0002
T	3.4502

and when corrected for torsion and referred to temp. 85°, $lg\,T^2 = 1.07597$

EXPERIMENTS OF VIBRATION. Set 2, with inertia ring.

No. of vibrations.	Time.	Temperature.	Extreme scale readings.	150 vib'ns at 85°.
0	4ʰ 09ᵐ 22ˢ.7	86° Fah.	356 and 246	
20	11 36.0			
40	13 49.3			
60	16 03.5			
80	18 16.6			
100	20 30.8			
150	26 04.6			16ᵐ 41ˢ.9
170	28 17.0			41.0
190	30 31.8			42.5
210	32 45.5			42.0
230	34 59.4			42.8
250	37 12.7	84.0	332.2 and 268	41.9

Mean . . . 16 42.02

Coefficient of torsion.

Tors. circle.	Scale.		Differences.
177°	298.2 and 302.5		
			3.6
267	303.8	304	
			5.7
87	293.5	303	
			1.8
177	301.0	299	

Mean (4). . . 2.8 = 2′.83

Observed time of 150 vib'ns,	1002ˢ.02
Time of one vibration,	6.6801
Correction for rate,	—0.0004
T_1	6.6797

and when corrected for torsion,
$lg\,T_1^2 = 1.64975$

EXPERIMENTS OF VIBRATION. Set 3.

No. of vibrations.	Time.	Temperature.	Extreme scale readings.	200 vib'ns at 83°.5.
0	4ʰ 47ᵐ 07ˢ.3	83°	252 and 355	
20	48 16.1			
40	49 25.3			
60	50 34.7			
80	51 43.7			
100	52 52.6			
200	58 38.5			11ᵐ 31ˢ.2
220	59 47.6			31.5
240	5 00 56.6			31.3
26	2 05.5			30.8
280	3 14.7			31.0
300	4 23.9	84	324 and 280.6	31.3

Mean	11 31.18
Observed time of 200 vibrations .	691ˢ.18
Time of one vibration .	3.4559
Correction for rate . . .	—0.0002
T . . .	3.4557

And when corrected for torsion and referred to 85° Fah., . $lg\,T^2 = 1.07737$
By set 1 we have . . . . $lg\,T^2 = 1.07597$

Mean 1.07667

The relation $K = K_1 \left(\frac{T^2}{T_1^2 - T^2}\right)$ gives $lgk — 0.19972$

We have therefore $lg\,(\pi^2 k) = 1.19402$ for temperature 85° Fah., and taking the coefficient of expansion of steel = 0.0000068 we find also $lg\,(\pi^2 k) = 1.19378$ for temperature 45°.

Determination of Magnetic Moment of Z 6 and of the Horizontal Force.

Experiments of deflection. June 13, 1862. Magnet Z 6 deflecting at right angles to magnet Z 1 suspended. Deflecting distance 1.35 feet.[1]

Circle readings, $11^h\ 0^m$. Temperature, 85°.

Magnet.	North end.	Order.	A.	B.	Order.			
E.	E.	1	7° 34′ 00″	34′ 40″				
	W.				2	1° 3′ 10″	3′ 40″	
	E.	3	7 32 30	33 40				
	W.				4	1 3 00	4 00	
	E.	5	7 33 10	34 10				
	Mean,		7 33.7			1 03.5		2u = 6° 30 .2
W.	W.				6	1 3 40	4 10	
	E.	7	7 37 00	38 00				
	W.				8	1 3 40	5 00	
	E.	9	7 36 00	36 40				
	W.				10	1 3 40	4 40	
	Mean,		7 36.9			1 04.1		2u = 6 32.8
	At		$11^h\ 32^m$	Temperature, 85°				u = 3 15.75

Line of detorsion, 177°

For the determination of the coefficient P depending upon the distribution of the free magnetism in the magnets, we have seven sets of observations of deflections at distances of 1.0 (in one case of 0.9) and of 1.3 foot. By means of the distances r and r_1 and the corresponding angles of deflection u and u_1 we have

$$P = -\frac{r^3 r_1^5 \sin u_1 - r_1^2 r^5 \sin u}{r_1^5 \sin u_1 - r^5 \sin u}$$

The observations themselves will be found in their proper place in this paper.

Locality.	Date.			r feet.	u	r_1 feet.	u_1	P
Cambridge,	1860.	July	3	1.0	9° 39′ 02″	1.3	4° 24′ 15″	—0.0153
Port Foulke,	1861.	July	2	0.9	49 52 36	1.3	14 39 25	+0.0044
"	"	"	7	1.0	34 12 41	1.3	15 13 51	—0.0606
"	"	"	8	1.0	33 58 36	1.3	15 08 08	—0.0607
"	"	"	9	1.0	34 14 04	1.3	15 24 53	—0.0851
Upernavik,	"	August	16	1.0	26 21 26	1.3	11 37 53	+0.0057
Godhavn,	"	September	7	1.0	19 45 38	1.3	8 59 49	—0.0382
							Mean	—0.0357

This large value of P is occasioned by the fact that the two magnets are of equal size.

[1] Correction for defect of wooden Scale + 0.0003 foot.

The horizontal force X, and the magnetic moment m of magnet Z 6[1], are obtained from the formulæ

$$mX = \frac{\pi^2 k}{T^2} \text{ and } \frac{m}{X} = \tfrac{1}{2}\, r^3 \sin u \left(1 - \frac{P}{r^2}\right)$$

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[1] In addition to the above observations at Washington, I have made the following with the *magnets exchanged*, from which we obtain an independent result.

EXPERIMENTS OF DEFLECTIONS. June 14, 1862. Magnet Z 1 deflecting at right angles to magnet Z 6 suspended. Deflecting distance 1.3 foot (correction + 0.0003)

The record and order of observations are the same as in the set of deflections given in the text, and are here given in a more condensed form

Set 1. $11^h\ 51^m$ Temp. 86° Fah.

	247°	48′	20″	50′	19″		242°	13′	48″	14′	25″	
E. E.	247	49	20	50	30	W.	242	14	10	14	50	$2u = 5°\ 35'\ 16''.2$
	247	48	40	50	20							
	247	48	25	49	20		242	12	00	12	15	
W. E.	247	47	20	48	20	W.	242	10	00	10	30	
							242	10	00	10	50	$2u = 5\ \ 37\ \ 20.3$

Line of detorsion 211° $1^h\ 25^m$ Temp. 90

Set 2. Distance 1 foot. $1^h\ 40^m$ Temp. 91°

	251°	06′	10″	06′	40″		238°	51′	00″	51′	20″	
E. E.	251	07	00	08	00	W.	238	51	00	51	40	$2u = 12°\ 16'\ 22''$
	251	08	30	09	20							
							238	57	10	57	00	
W. E.	251	12	00	13	00	W.	238	57	00	58	20	$2u = 12\ \ 15\ \ 12$
	251	12	59	14	00		238	58	00	59	20	

$2^h\ 40^m$; at temp. 92°

From these deflections we find $P = -0.01365$ and $lg \frac{m}{X} = 8.75381$

EXPERIMENTS OF VIBRATION. June 16, 1862.

Magnet Z 1 suspended. Inertia ring C. Chronometer 1287, gains 6ˢ a day.

No. of vib'ns.	Time.			Temp.	Extreme scale readings.	150 vibrations at 71°.
0	5^h	17^m	$52^s.0$	70°	240	
20		20	23.5		and	
40		22	55.8		365	
60		25	27.0			
80		27	58.8			
100		30	30.3			
150		36	49.0			$18^m\ 57^s.0$
170		39	21.8			58.3
190		41	52.5			56.7
210		44	24.0		265	57.0
230		46	55.8		and.	57.0
250		49	27.8	72°	330	57.5
		Mean	.	.	.	18 57.25

Observed time of 150 vib'ns,	$1137^s.25$
Time of one vibration,	7.5816
Correction for rate,	—0.0004
	7.5812

and when corrected for torsion and referred to 89°.7 Fah.

$lg\, T_1^2 = 1.76132$

Combining the deflections with the vibrations, we find —

From first set	$X = 4.286$	and $m = 0.3062$ at 85° Fah	
From last set	4.279	0.3057	
Mean,	4.283	0.3060	

Magnet Z 1 suspended without ring

No. of vib'ns.	Time.			Temp.	Extreme scale readings.	200 vibrations at 78°.
0	6^h	12^m	$48^s.5$	78°	270	
20		14	06.5		and	
40		15	25.0		339	
60		16	43.3			
80		18	01.9			
100		19	19.0			
200		25	50.5			$13^m\ 02^s.0$
220		27	10.5			04.0
240		28	28.3			03.3
260		29	46.5		286	03.2
280		31	05.0		and	03.1
300		32	23.6	78°	315	04.6
Mean						13 03.37

Observed time of 200 vib'ns, $783^s.37$
Time of one vibration, 3.9168
Correction for rate, —0.0002

3.9166

and when corrected for torsion and referred to 89°.7 Fah.

$lg\,T^2 = 1.18702$

We find $lgk_1 = 0.63779$ at 89°.7
$lgk = 0.19809$ for Z 1
$lg\,mX = 0.00537$
$X = 4.323$ and $m = 0.2342$ at 89°.7 Fah.; magnet Z 1

To compare the above values for the horizontal force with similar determinations at Washington, I have given a complete table of results, as far as known to me. See U. S. Coast Survey Report of 1861, Appendix N. 22, also Coast Survey Report of 1863. From my observations, in 1858, in connection with Kane's Arctic Expedition, I deduce $X = 4.255$; and for 1862.5 we have the means of the three values given above, or 4.296.

Complete table of horizontal intensities determined at Washington, D. C.

No.	Year.	Observer.	Locality.	X	No.	Year.	Observer.	Locality.	X
1	1842.5	Lefroy	Capitol Grounds	4.347	10	1856.7	Schott	Coast Sur. Office	4.309
2	1844.5	Locke	Georgetown	4.282	11	1856.7	"	Capitol Grounds	4.308
3	1844.5	"	Capitol Grounds	4.313	12	1858.3	"	Coast Sur. Office	4.255
4	1844.5	"	Mag. Obs'y, Cpt.	4.282	13	1859.6	"	" " "	4.307
5	1845.2	Lee	Coast Sur. Office	4.240	14	1860.7	"	" " "	4.319
6	1845.9	"	" " "	4.233	15	1862.5	"	" " "	4.296
7	1851.5	Dean	Georgetown	4.229	16	1862.6	"	" " "	4.296
8	1855.7	Schott	Smithsonian Inst.	4.338	17	1863.6	"	" " "	4.282
9	1855.7	"	Georgetown	4.250					
			Mean . . .			1853.6			4.287

Mean, omitting Georgetown values, 4.295

These values were determined with different instruments and magnets; the X at Georgetown heights appears to be smaller than the Washington value proper (the two positions are 4 miles apart).

OBSERVATIONS AT CAMBRIDGE, MASS. July 3, 1860.

Harvard College Observatory. A. Sonntag, observer.

Experiments of vibration. Magnet Z 6 suspended. Time noted by sidereal chronometer Bond 236. Temperature, 76° Fah.

No. of vib'n.	Left to right.	No. of vib'n.	Left to right.	Time of 50 double vibrations.
0	12^h 18^m $53^s.2$	50	12^h 25^m $09^s.7$	6^m $16^s.5$
1	19 00.8	51	17.1	16.3
2	08.3	52	24.8	16.5
3	15.8	53	32.2	16.4
4	23.2	54	39.7	16.5
5	30.8	55	47.3	16.5
6	38.2	56	54.8	16.6
7	45.8	57	26 02.3	16.5
8	53.3	58	09.8	16.5
9	20 00.9	59	17.3	16.4
10	08.2	60	24.8	16.6

Set 1
Time of a double vib'n, $7^s.5296$

Mean . . 6 16.18

Arc at commencement 150 and 460
" end 180 420

No. of vib'n.	Right to left.	No. of vib'n.	Right to left.	Time of 50 double vibrations.
0	12^h 20^m $49^s.5$	50	12^h 27^m $06^s.3$	6^m $16^s.8$
1	57.2	51	13.8	16.6
2	21 04.8	52	21.2	16.4
3	12.3	53	28.8	16.5
4	20.0	54	36.2	16.2
5	27.4	55	43.9	16.5
6	35.0	56	51.2	16.2
7	42.5	57	59.0	16.5
8	50.1	58	28 06.3	16.2
9	57.7	59	14.0	16.3
10	22 05.2	60	21.5	16.3

Set 2.
Time of a double vibration $7^s.5282$

Mean . . . 6 16.41

Arc at commencement 170 and 435
" end 190 410

Time of 2 vibrations, 7.5289

Correction for rate, —0.0206

(By sets 1 and 2), 7.5083

EXPERIMENTS OF VIBRATIONS, continued. Temperature, 74° Fah.

No. of vibration.	Left to right.	Time of 200 double vibrations.
200	12^h 43^m $59^s.3$	25^m $06^s.1$
201	44 06.8	06.0
202	14.4	06.1
203	22.7	06.9
204	29.2	06.0
205	36.9	06.1
206	44.3	06.1
207	51.9	06.1
208	59.4	06.1
209	45 07.0	06.1
210	14.6	06.4

Set 3.
Time of a double vibration, $7^s.5309$

Arc, 252 and 338 Mean, 25 06.18

EXPERIMENTS OF VIBRATIONS, continued. Temperature 74° Fah

No. of vibration.	Right to Left.	Time of 200 double vibrations.	
200	12^h 45^m $56^s.0$	25^m $06^s.5$	
201	46 03.7	06.5	
202	11.1	06.3	
203	18.8	06.5	Set 4.
204	26.2	06.2	Time of a double vibration
205	33.8	06.4	$7^s.5316$
206	41.3	06.3	
207	48.8	06.3	
208	56.2	06.1	
209	04.0	06.3	
210	11.4	06.2	

Arc 250 and 340 Mean, 25 06.33

Time of 2 vibrations	7.5312	
Correction for rate	—0.0206	
By sets 3 and 4	7.5106	weight 4
By sets 1 and 2	7.5083	weight 1
$2\,T^1 =$	7.5101	at 74°.4 Fah
$T^1 =$	3.7550	"

And when corrected for torsion and referred to temperature 72°.75 $lg\,T^2 = 1.14976$

Observations for Torsion.

Tor. cir.	Scale.		Differences.
69°	298.6 and 308.8		
			6.8
159	308	313	
			17.0
339	285	302	
			10.0
69	295	312	

Mean (4) . . . 8.45 = 8′.57

EXPERIMENTS OF DEFLECTION. July 3, 1860.

Magnet Z 6 deflecting; Z 1 suspended. Distance 1.0 foot. Temperature, 73°.

Magnet.	Circle reading.		Set 1.	
S. end east	145° 54′ 20″	54′ 40″	145° 50′ 05″	19° 18′ 05″
N. " west	145 45 40	45 40		
S. " "	126 40 40	41 20	126 32 00	9 39 02 = u
N. " east	126 23 00	23 00		

Distance 1.3 foot. Temperature, 72°.5.

Magnet.	Circle reading.		Set 1.	
N. end east	131 43 00	43 40	131 46 00	8 48 30
S. " west	131 48 20	49 00		
N. " "	140 34 00	35 00	140 34 30	4 24 15 = u
S. " east	140 34 00	35 00		

From $lg\ mX = 0.04019$

and $lg\ \dfrac{m}{X} = 8.92999$ we find $X = 3.607$[1]

and $m = 0.3070$ at 73°

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[1] For comparison the following four values were taken from the Coast Survey Report of 1861, Appendix No. 22. Cambridge $\phi = 42°\ 23'$ and $\lambda = 71°\ 07'$

No.	Year.	Observers.	X
1	1842.5	Locke	3.657
2	1842.8	Lefroy	3.665
3	1845.5	Locke	3.618
4	1856.6	Friesach	3.542
5	1860.6	Sonntag	3.607

Prövon, North Greenland, August, 1860

Magnet Z 1 suspended.[1] A. Sonntag, observer. August 9 P. M.

Set 1.		Vibrations.			200 vibrations.	
L. to R.	0	2ʰ 00ᵐ 12ˢ.0	200	2ʰ 21ᵐ 39ˢ.8	21ᵐ 27ˢ.8	
R. to L.	1	18.5	201	46.8	28.3	
L. to R.	2	25.0	202	53.0	28.0	
R. to L.	3	31.3	203	59	27.7	
L. to R.	4	37.8	204	22 05.5	27.7	
R. to L.	5	43.8	205	12.8	29.0	
L. to R.	6	50.8	206	18.8	28.0	
R. to L.	7	57.2	207	25.8	28.6	200 vibrations = 1288ˢ.32
L. to R.	8	01 03.3	208	32.0	28.7	1 vibration 6.4416
R. to L.	9	09.8	209	38.8	29.0	
L. to R.	10	16.2	210	44.9	28.7	

Arc: 152 and 454 218 and 343 Mean, 21 28.32 at 41° Fah.

Set 2.		Vibrations.				
L. to R.	30	2ʰ 03ᵐ 24ˢ.6	230	2ʰ 24ᵐ 53ˢ.5	21ᵐ 28ˢ.9	
R. to L.	31	30.8	231	25 02	31.2	
L. to R.	32	37.5	232	06.8	29.3	
R. to L.	33	44.0	233	15.0	31.0	
L. to R.	34	50.2	234	19.8	29.6	200 vibrations = 1290ˢ.39
R. to L.	35	56.5	235	27.8	31.3	1 vibration 6.4520
L. to R.	36	04 03.2	236	32.8	29.6	
R. to L.	37	09.2	237	40.3	31.6	
L. to R.	38	15.8	238	45.8	30.0	
R. to L.	39	22.6	239	53.7	31.7	
L. to R.	40	28.9	240	56.0	30.1	

Arc: 180 and 442 222 and 333 Mean, 21 30.39 at 41° Fah.

Set 3.		Vibrations.				
L. to R.	0	2ʰ 33ᵐ 22ˢ.2	200	2ʰ 54ᵐ 55ˢ.3	21ᵐ 33ˢ.1	
R. to L.	1	29.0	201	55 01.7	32.7	
L. to R.	2	35.6	202	08.0	32.4	
R. to L.	3	41.6	203	14.8	33.2	
L. to R.	4	48.2	204	21.0	32.8	200 vibrations = 1292ˢ.72
R. to L.	5	55.1	205	27.4	32.3	1 vibration 6.4636
L. to R.	6	34 01.3	206	34.0	32.7	
R. to L.	7	07.3	207	40.0	32.7	
L. to R.	8	14.2	208	47.0	32.8	
R. to L.	9	20.8	209	53.2	32.4	
L. to R.	10	27.0	210	59.8	32.8	

Arc: 143 and 518 228 and 368 Mean, 21 32.72 at 39° Fah.

Set 4.		Vibrations.				
L. to R.	30	2ʰ 36ᵐ 36ˢ.7	230	2ʰ 58ᵐ 08ˢ.2	21ᵐ 31ˢ.5	
R. to L.	31	42.8	231	15.2	32.4	
L. to R.	32	50	232	21	31.0	
R. to L.	33	56	233	28	32.0	
L. to R.	34	37 03	234	33.8	30.8	200 vibrations = 1291ˢ.54
R. to L.	35	09	235	40.8	31.8	1 vibration 6.4577
L. to R.	36	16	236	47	31.0	
R. to L.	37	22	237	53.8	31.8	
L. to R.	38	28	238	59.8	31.8	
R. to L.	39	35	239	59 06.8	31.8	
L. to R.	40	41.8	240	12.8	31.0	

Arc: 158 and 470 228 and 350 Mean, 21 31.54 at 39° Fah.

[1] That Z 1 was suspended is proved also by the resulting X; Z 6 ought to have been suspended.

The mean of four sets gives 1 vibration 6.4537 at 40° Fah. The value of m for Z 1, as determined at Washington at 89°.7, = 0.2342, at 40° it becomes 0.2365; we have also $lg\,(\pi^2 k) = 1.19239$ at 89°.7, and 1.19209 at 40°. Correcting for torsion we find $lg\ mX = 9.57134$ and $X = 1.576$.

Port Foulke, SMITH STRAIT.

Observations at the Port Foulke Observatory.

Set 1. Deflections. $3^h\ 39^m$ P. M., July 2, 1861.

Magnet Z 1 suspended, Z 6 deflecting; distance 1.3 foot.

Magnet.	North end.	Circle.		Temperature.	
E.	E.	38° 52′ 40″	53′ 10″	40°.5	
"	"	38 54 00	54 50		$2u = 28° 51' 02''$
"	W.	10 00 40	01 40		
"	"	10 04 00	04 10	39	
W.	"	9 40 20	41 40		
"	"	9 42 10	43 10		$2u = 29\ 46\ 38$
"	E.	39 29 20	30 10		
"	"	39 26 40	27 40	39.8	
			Mean . . .	39.8	$u = 14\ 39\ 25$

Set 2. Deflections. Distance 0.9 foot. $4^h\ 38^m$.

W.	E.	76 15 20	15 20	39	
"	"	76 17 00	17 00		$2u = 101\ 05\ 58$
"	W.	335 10 30	11 00		
"	"	335 09 20	10 00		
E.	"	338 01 40	02 00	38	
"	"	337 59 30	60 20		$2u = 98\ 24\ 26$
"	E.	76 23 50	24 00		
"	"	76 26 40	26 40	39.2	
			Mean . . .	38.7	$u = 49\ 52\ 36$

Set 3. Deflections. Distance 1.0 foot. A. M. July 7, 1861.

E.	E.	26 44 40	45 00	44.2	
"	"	26 43 20	44 00		$2u = 68\ 24\ 25$
"	W.	318 19 20	20 00		
"	"	318 19 40	20 20	45.0	
W.	"	318 19 40	20 40		
"	"	318 19 40	20 20	43	$2u = 68\ 26\ 20$
"	E.	26 46 20	47 20		
"	"	26 45 20	46 00	43	
			Mean . . .	43.8	$u = 34\ 12\ 41$

Observations for Torsion.

Torsion circle.	Scale.	Differences.	
280° 30′	300		
370 30	311.8	11.8	
190 30	292.0	19.8	Mean (4) = 10.0 = 10′.1
280 30	300.5	8.5	

Set 4. Deflections. Distance 1.3 foot. A. M. July 7, 1861.

W.	E.	7° 47′ 00″	47′ 20″	42°	
"	"	7 47 20	47 40		$2u = 30° 27' 15''$
"	W.	337 19 40	20 40	42	
"	"	337 19 20	20 40		
E.	"	337 25 20	26 00	41.6	
"	"	337 25 20	26 00		$2u = 30\ 28\ 10$
"	E.	7 53 20	54 20	41.2	
"	"	7 53 20	54 20	40	
			Mean . . .	41.4	$u = 15\ 13\ 51$

Set 5. Vibrations. July 7, 1861.

Magnet Z 6 suspended. M. T. Pocket chronometer; rate nearly zero. Temperature, 51°.

Number.	Chronometer.	Number.	Chronometer.	300 vibrations.	
0	11h 01m 21s	300	11h 35m 16s	33m 55s	
10	02 29	310	36 24	33 55	Observed time of
20	03 36	320	37 32	33 56	300 vibrations, 2035s.5
30	04 44	330	38 40	33 56	Time of one, 6.7850
40	05 52	340	39 47	33 55	
50	06 59	350	40 55	33 56	
100	12 38.5	200	23 57	33 55.5	

Arc: 204 and 402 at beginning, or 0
294.5 305 at end, or 350 vib's.

Observations for Torsion.

Torsion circle.	Scale.	Differences.	
50°	300		
140	320.7	20.7	
230	286	34.7	Mean (4) = 17.5 = 17'.7
50	300.5	14.5	

Set 6. Vibrations. P. M. July 8, 1861.

Magnet Z 6 suspended on 4 fibres. Temperature, 41°.

Number.	Chronometer.	Number.	Chronometer.	300 vibrations.	
0	1h 13m 03s	300	1h 47m 02s	33m 59s.0	
10	14 10.5	310	48 09	33 58.5	Observed time of
20	15 18	320	49 17.2	33 59.2	300 vibrations, 2038s.86
30	16 26	330	50 25	33 59.0	Time of one, 6.7962
40	17 33.8	340	51 32.8	33 59.0	
50	18 42	350	52 40.5	33 58.5	
100	24 21.2	200	35 41	33 58.86	

Arc: 205 + 395 at 0
264 335 at 200
283 317.5 at 350 vib's.

Set 7. Vibrations. Temperature, 40°.

0	2h 04m 08s	300	2h 38m 05s	33m 57s.0	
10	05 15	310	39 12.5	33 57.5	Observed time of
20	06 22	320	40 20.5	33 58.5	300 vibrations, 2038s.25
30	07 30	330	41 28.5	33 58.5	Time of one, 6.7942
40	08 38	340	42 37	33 59.0	
50	09 46	350	43 45	33 59.0	
100	15 26	200	26 46	33 58.25	

Arc: 180 and 420 at 0
254 343 at 200
279 321 at 350 vib's.

Set 8. Deflections. P. M. July 8, 1861.

Magnet Z 1 suspended, Z 6 deflecting; distance 1.0 foot.

E.	E.	10° 12′ 20″	13′ 20″	38°	$2u = 67° 40′ 20″$
"	W.	302 32 10	32 50	37.5	
W.	E.	11 50 00	50 50	38	$2u = 68\ 14\ 05$
"	W.	303 36 00	36 40	38	
			Mean . .	37.9	$u = 33\ 58\ 36$

Set 9. Deflections. Distance 1.3 foot.

W.	W.	321° 38′ 20″	39′ 00″	38°	$2u = 30° 32′ 55″$
"	E.	352 11 10	12 00	38.5	
E.	W.	321 48 20	49 20	39.5	$2u = 29\ 59\ 40$
"	E.	351 48 00	49 00	38	
			Mean . . .	38.5	$u = 15\ 08\ 08$

Set 10. Deflections. July 9, 1861.

Z 1 suspended, Z 6 deflecting; distance 1.0 foot.

E.	E.	11° 07′ 20″	08′ 20″	42°	$2u = 68° 26′ 40″$
"	W.	302 40 40	41 40	42.5	
W.	E.	10 45 00	45 50	43	$2u = 68\ 29\ 35$
"	W.	362 15 30	16 10	48	
			Mean . . .	43.9	$u = 34\ 14\ 04$

Observations for Torsion.

Torsion circle.	Scale.	Differences.	
90	300.5		
180	314.0	13.5	
360	286.5	27.5	Mean (4) = 13.9 = 14′.1
90	301.0	14.5	

Set 11. Deflections. Distance 1.3 foot. July 9, 1861.

W.	W.	321° 22′ 40″	23′ 30″	48.°5	$2u = 30° 20′ 20″$
"	E.	351 43 00	43 50	46	
E.	W.	319 31 10	32 00	44	$2u = 31\ 19\ 10$
"	E.	350 50 10	51 20	47	
			Mean . . .	46.4	$u = 15\ 24\ 53$

Set 12. Vibrations. Temperature 39°. P. M. July 9, 1861.

Z 6 suspended.

0	9h 50m 54s	300	10h 24m 31s	33m 37s.0	
10	52 01.5	310	25 41	33 39.5	Observed time of
20	53 09	320	26 48.5	33 39.5	300 vibrations, 2019s.08
30	54 16.5	330	27 56	33 39.5	Time of one, 6.7303
40	55 23	340	29 02	33 39.0	
50	56 30	350	30 10	33 40.0	
100	10 02 06	200	13 17.5	33 39.08	

Arc: 204 and 462 at 0
255 363 " 200
280 319 " 350 vib's.

Set 13. Vibrations. Temperature, 41°. P. M. July 9, 1861.

0	11h 23m 44s	300	11h 57m 23s	33m 39s.0	
10	24 51	310	58 30	33 39.0	
20	25 58.5	320	59 38	33 39.5	Observed time of
30	27 06	330	12 00 45.5	33 39.5	300 vibrations, 2019s.25
40	28 12.5	340	01 52	33 39.5	Time of one, 6.7308
50	29 21	350	03 00	33 39.0	
100	34 59	200	11 46 10	33 39.25	

Arc: 170 and 435 at 0
262 340 " 200
288 312 " 352 vib's.

The combination of the deflection and vibration results is shown in the following table. The first three deflections having no corresponding vibrations, the value of m was deduced from the remaining five results viz: 0.316 at 41°.6 Fah., hence for the temperature t of these deflections we have $m = 0.316\,(1 - 0.0002\,(t - 41°.6))$. The vibrations have been referred to the temperature of the deflections by correcting the squares of the times by $1 - q\,(t' - t)$, the temperature of the deflections being t and that of the vibrations t'; they were also corrected for torsion $\left(1 + \frac{H}{F}\right)$. The average value of P has been used.

Set.	$lg \frac{m}{X}$	t	Set.	$lg\, mX$	$lg\, m$	X	m	
1	9.45303	39.°8	—	- - - - -	- - - - -	1.117	- - -	
2	9.46389	38.7	—	- - - - -	- - - - -	1.089	- - -	
3	9.46412	43.8	—	- - - - -	- - - - -	1.082	- - -	
4	9.46934	41.4	5	9.53037	9.49985	1.073	0.316	
8	9.46150	37.9	6	9.52832	9.49491	1.080	0.313	
9	9.46666	38.5	7	9.52844	9.49755	1.074	0.314	
10	9.46438	43.9	12	9.53615	9.40026	1.087	0.316	
11	9.47442	46.4	13	9.53604	9.50523	1.074	0.320	at 41°.6
				Mean . . .		1.084	0.316	

Netlik, WHALE SOUND. August 4, 1861

Set 1. Vibrations. Magnet Z 6 suspended. Temperature, 48

Chronometer $4^h\ 40^m\ 04^s$ fast of Greenwich time.

0	$2^h\ 25^m\ 53^s$	300	$2^h\ 59^m\ 32^s$	$33^m\ 39^s.0$	
10	27 01	310	3 00 40	33 39.0	Observed time of
20	28 08	320	01 47.5	33 39.5	300 vibrations, $2020^s.08$
30	29 15	350	02 55.5	33 40.5	Time of one, 6.7336
40	30 22	340	04 03	33 41.5	
50	31 29	350	05 10.5	33 41.0	
100	37 06.5	200	2 48 19.5	33 40.08	

Arc: 170.5 and 425 at 0
261 342 " 200
278 322 " 350 vib's.

Set 2. Vibrations. Temperature, 46°.

0	$3^h\ 10^m\ 42^s.5$	300	$3^h\ 44^m\ 24^s$	$33^m\ 41^s.5$	
10	11 50	310	45 32	33 42.0	Observed time of
20	12 57.5	320	46 39.5	33 42.0	300 vibrations, $2021^s.83$
30	14 04.5	330	47 46	33 41.5	Time of one, 6 7394
40	15 12	340	48 54	3 42.0	
50	16 20	350	50 02	33 42.0	
100	21 56.5	200	3 37 10.5	33 41.83	

Arc: 190 and 425 at 0
255 345 " 200
278 322 " 350 vib's.

Observations for Torsion.

Torsion circle.	Scale.	Differences.	
60° 30′	300		
150 30	320	20.0	
330 30	286	34.0	Mean (4) = 17 1 = 17′.3
60 30	300.5	14.5	

Set 3. Deflections.

Magnet Z 1 suspended, Z 6 deflecting. Distance 1 foot. P. M. August 4.

W.	E.	39° 21′ 10″	24′ 40″	42°	$2u = 16°\ 30'\ 00''$
"	W.	332 54 00	54 50	40	
E.	"	332 45 20	45 40	39	$2u = 66\ 38\ 50$
"	E.	39 21 00	21 40	38	
		Mean . . .		39.7	$u = 33\ 17\ 12$

Combining the mean of set 1 and set 2 (6.7364) with the angle of set 3, correcting the first for torsion and referring it to 39°.7 Fah., we find

$$lg\frac{m}{X} = 9.45364 \quad \text{and} \quad X = 1.110$$

$$lg\, mX = 9.53614 \qquad m = 0.312 \text{ at } 39°.7 \text{ Fah.}$$

Upernavik, North Greenland. August 16, 1861.

At flagstaff. Chronometer 8^s fast of Greenwich time.

Set 1. Experiments of vibration. Temperature, 47°.

Magnet Z 1[1] suspended.

0	$5^h\ 15^m\ 47^s$	300	$5^h\ 50^m\ 38^s$	$34^m\ 51^s$	Observed time of
10	16 57	310	51 47	34 50	300 vib'ns, $= 2091^s.17$
20	18 06	320	52 57	34 51	Time of one, 6.9706
30	19 16	330	54 07	34 51	
40	20 25	340	55 17	34 52	
50	21 35	350	56 27	34 52	
100	27 24	200	39 01	34 51.17	

Arc: 193 and 413 at 0
266 334 " 200
282.5 318 " 350 vib's.

Set 2. Vibrations. Temperature, 47°.

0	$6^h\ 00^m\ 00^s$	300	$6^h\ 34^m\ 48^s$	$34^m\ 48^s$	Observed time of
10	01 10	310	35 58	34 48	300 vibrations, $2088^s.08$
20	02 20	320	36 08	34 48	Time of one, 6.9603
30	03 29	330	38 17.5	34 48.5	
40	04 39	340	39 27	34 48	
50	05 49	350	40 37	34 48	
100	11 37	200	23 12	34 48.08	

Arc: 194 and 399 at 0
261.5 338 " 200
280 320 " 350 vib's.

Set 3. Vibrations.[2] Temperature, 46°.

0	$7^h\ 01^m\ 18^s$	300	$7^h\ 35^m\ 09^s$	$34^m\ 51^s.0$	Observed time of
10	02 27	310	36 18.5	34 51.5	300 vibrations, $2091^s.08$
20	03 36.5	320	37 28	34 51.5	Time of one, 6.9703
30	04 46.5	330	38 37	34 50.5	
40	05 56	340	39 47	34 51.0	
50	07 06	350	40 57	34 51.0	
100	12 53	200	24 32	34 51.08	

Arc: 192 and 415 at 0
265 333 " 200
284.5 315.5 " 350 vib's.

Set 4. Deflections.

Magnet Z 1 suspended, Z 6 deflecting. Distance 1 foot.

E.	E.	45° 32′ 40″	33′ 40″	48°	$2u = 52°\ 40'\ 10''$
"	W.	352 52 40	53 20	44	
W.	E.	45 23 30	24 00	47	$2u = 52\ \ 45\ \ 35$
"	W.	352 37 50	38 30	46	
			Mean . . .	46.2	$u = 26\ \ 21\ \ 26$

[1] The correctness of the record is sustained by the resulting X.

[2] The record of 300 to 350 vibrations is 1^m too small, as appears plainly by comparing the times of 0, 100, 200, and 300 vibrations.

Set 5. Deflections. Distance 1.3 foot.

E.	E.	30° 36′ 30″	37′ 40″	47°	$2u = 23°\ 15'\ 55''$
"	W.	7 20 40	21 40	45	
W.	E.	30 39 40	40 10	43	$2u = 23\ \ 15\ \ 35$
"	W.	7 24 00	24 40	43	
			Mean . . .	44.5	$u = 11\ \ 37\ \ 53$

The mean result of set 1 and set 2 is 6.9654 at 47°, and of set 2 and set 3, 6.9653 at 46.5; if we correct these for torsion, and use $lg\ \pi^2 k$ (for Z 1) = 1.19212, and lgm (for Z 1) = 9.37310, the vibrations give X = 1.355 and 1.355. For the deflections we use lgm (for Z 6) 9.45164 and 9.49178 (the value of m being 0.310 at 50°) and find X = 1.349 and 1.372. The mean value of the four determinations is 1.358.

The magnetic moment of Z 6 appears to be very nearly constant, which is due to the age of the magnet; at 50° Fah. we have 0.308, 0.315, 0.311, 0.309, and 0.308 as found at Cambridge, Port Foulke, Netlik, Godhavn, and Washington, respectively.

Godhavn, Disco Island, Greenland. August and September, 1861.

Station in the garden at the rear of the Inspector's house.

Set 1. Vibrations. Z 6 suspended. September 7, 1861.

0	$2^h\ 28^m\ 42^s$	300	$2^h\ 55^m\ 25^s$	$26^m\ 43^s.0$	
10	29 34.5	310	56 19	26 44.5	Observed time of
20	30 28.5	320	57 12.5	26 44.0	300 vibrations, $1604^s.08$
30	31 22	330	58 06	26 44.0	Time of one, 5.3469
40	32 15.5	340	59 00	26 44.5	
50	33 09	350	59 53.5	26 44.5	
100	37 35.5	200	2 46 30	26 44.08	

Arc: 207 and 402 at 0 Temperature, 38°
261 339 " 200
288 312 " 350 vib's.

Set 2. Vibrations. Temperature, 38°.

0	$3^h\ 28^m\ 30^s$	300	$3^h\ 55^m\ 14^s$	$26^m\ 44^s.0$	
10	29 24	310	56 07	26 43.0	Observed time of
20	30 17	320	57 01	26 44.0	300 vibrations, $1603^s.58$
30	31 11	330	57 54	26 43.0	Time of one, 5.3453
40	32 04.5	340	58 48	26 43.5	
50	32 57	350	59 41	26 44.0	
100	37 25	200	3 46 19.5	26 43.58	

Arc: 185 and 425 at 0
257 347 " 200
280 320 " 350 vib's.

Set 3. Deflections. Z 1 suspended, Z 6 deflecting. Distance 1 foot.

E.	E.	244° 20′ 40″	21′ 40″	46°	
"	W.	205 30 40	31 40	47	$2u = 39°\ 04'\ 10''$
W.	E.	245 16 00	17 00	47	
"	W.	205 58 00	58 20	46	
E.	E.	244 19 20	20 20	46	
"	W.	205 28 20	29 10	46	$2u = 39\ \ 58\ \ 20$
W.	E.	245 17 50	18 40	45	
"	W.	204 12 40	12 40	45	
			Mean . . .	46	$u = 19\ \ 45\ \ 38$

During the above set a strong wind was blowing which disturbed the magnet a little.

	Set 4.	Deflections.	Distance 1.3 foot.	September 7, 1861.	
E.	E.	233° 43′ 40″	44′ 10″	45°	$2u = 17° 20′ 40″$
"	W.	216 23 10	23 20	44	
W.	E.	234 10 00	11 00	40	$2u = 18\ 38\ 35$
"	W.	215 31 40	32 10	40	
		Mean.	. . . .	42.2	$u = 8\ 59\ 49$

Correcting for torsion and for difference of temperature we find

$lg \frac{m}{X} = 9.24322$ and 9.24404 | hence $X = 1.763$ and 1.762

$lg\, mX = 9.73564$ 9.73622 | and $m = 0.309$ 0.309 at 46° at 42°

RECAPITULATION OF PRECEDING VALUES OF HORIZONTAL FORCE.

No.	Locality.	Latitude.	Longitude.	X	Date.	Observer.
1	Cambridge, Mass. . . .	42° 23′	71° 07	3.607	July, 1860	A. Sonntag
2	Pröven, North Greenland	72 23	55 33	1.576	Aug. 1860	A. Sonntag
3	Port Foulke, Smith Strait	78 18	73 00	1.084	July, 1861	H. G. Radcliff
4	Netlik, Whale Sound . .	77 08	71 22	1.110	Aug. 1861	H. G. Radcliff
5	Upernavik, N. Greenland	72 47	56 03	1.358	Aug. 1861	H. G. Radcliff
6	Godhavn, Disco, "	69 12	53 28	1.762	Sept. 1861	H. G. Radcliff
7	Washington, D. C., U. S.	38 53	77 00	4.296	June, 1862	C. A. Schott

The horizontal component X of the magnetic force is expressed in English units (feet and grains).

To the above two stations (Port Foulke and Netlik) at and near Smith Strait, I have added the following three stations occupied for horizontal force by Dr. Kane's party in 1854 and 1855.

Van Rensselaer Harbor,	$\phi = 78° 37′$	$\lambda = 70° 53′$	$X = 1.139$	(1854)
Hakluyt Island,	77 23	73 10	1.344	(1855)
Near Cape York,	76 03	68 00	1.573	(1855)

The observed horizontal force H, at these five stations, is represented by the formula

$$H = 1.250 - 0.11\ \Delta\phi - 0.21\ \Delta\lambda \cos \phi$$

$$\text{where } \Delta\phi = \phi - 77°.50 \text{ and } \Delta\lambda = \lambda - 71°.29$$

It was found, however, that the determination at Hakluyt Island, where the horizontal force appears too large, had the effect of inclining the isodynamic lines more than was warranted by values of more southern stations. I have, therefore, given the determination at Hakluyt the weight one-half, and find

$$H = 1.250 - 0.07\ \Delta\phi - 0.30\ \Delta\lambda \cos \phi$$

by means of which equation the isodynamic lines of 1.0, 1.1, 1.2, 1.3, and 1.4 were laid down on the chart.

The observations are represented as follows:—

	Obs. H.	Comp. H.	Diff.
Port Foulke	1.084	1.089	—0.005
Netlik	1.110	1.270	—0.160
Van Rensselaer Harbor	1.139	1.196	—0.057
Hakluyt	1.344	1.132	+0.212
Near Cape York	1.573	1.588	—0.015

The probable error of a single representation is ± 0.10, and of any resulting line ± 0.05 nearly.

MAGNETIC INCLINATION.

Observations and Results.

Port Foulke, SMITH STRAIT. July, 1861.

Observations at the Port Foulke Observatory.

Set 1. Needle II, marked end South. July 4, $10^h\ 13^m$ A. M.

Circle East.				Circle West			
Face East		Face West.		Face East.		Face West.	
N.	S.	N.	S.	N.	S.	N.	S.
84° 55′	85° 07′	84° 45′	84° 45′	85° 15′	85° 07′	85° 15′	85° 15′
85 00	85 00	84 45	84 45	85 15	85 07	85 18	85 15
Mean . . 84° 53′				85° 13′			

Mean. . . . 85° 03′

Needle II, marked end North

Circle West.				Circle East.			
Face West.		Face East.		Face West.		Face East.	
85° 00′	85° 00′	85° 15′	85° 08′	84° 45′	85° 00′	84° 45′	84° 45′
84 52	84 53	85 15	85 08	84 45	85 00	84 52	84 52
Mean . . 85° 04′				84° 50′			

Mean . . . . 84° 57′

Dip by needle II, 85° 00′.

Set 2. Needle III, marked end South. July 4, $11^h\ 43^m$ A. M.

E.				W.			
E.		W.		E.		W.	
85° 00′	85° 07′	85° 00′	85° 15′	84° 55	84° 45′	84° 60′	84° 55′
15	20	15	30	60	60′	45	40
85° 13′				84° 53′			

85° 03′

Needle III, marked end North.

W.				E.			
W.		E.		W.		E.	
85° 00′	84° 55′	85° 00′	84° 55′	85° 30′	85° 45′	84° 45′	84° 65′
07	60	08	60	30	42	45	50
85° 01′				85° 14′			

35° 07′

Dip by needle III, 85° 05′

Set 3. Needle II, marked end South. July 5, $10^h\ 59^m$ A. M

E.				W.			
E.		W.		E.		W.	
85° 30′	85° 35′	84° 15′	84° 16′	85° 15′	85° 13′	85° 15′	85° 00′
15	30	17	17	17	15	15	05
84° 52′				85° 12′			

85° 02′

Needle II, marked end North.

W.				E.			
W.		E.		W.		E.	
85° 15′	85° 17′	85° 20′	85° 15′	84° 45′	84° 52′	84° 33′	84° 45′
10	05	25	15	45	52	45	50
85° 15′				84° 46′			

84° 00′

Dip by needle II, 85° 01′

Set 4. Needle III, marked end South. July 5.

E.				W.			
E.		W.		E.		W.	
84° 50′	84° 50′	85° 00′	85° 15′	85° 15′	85° 20′	85° 13′	85° 02′
30	30	15	25	00	07	20	13
84° 57′				85° 11′			

85° 04

Needle III, marked end North.

W.				E.			
W.		E.		W.		E.	
85° 38′	85° 30′	85° 28′	85° 20′	84° 55′	85° 18′	84° 30′	84° 24′
40	30	28	20	67	13	60	62
85° 27′				84° 56′			

85° 11′

Dip by needle III, 85° 08′

Set 5. Needle II, marked end North. July 7 P. M.

W.				E.			
W.		E.		W.		E.	
84° 67′	84° 67′	85° 36′	85° 30′	84° 30′	84° 30′	84° 55′	85° 00′
55	50	32	30	26	30	77	20
85° 16′				84° 48′			

85° 02′

Needle II, marked end South.

E.				W.			
E.		W.		E.		W.	
84° 40′	84° 26′	84° 38′	84° 45′	85° 00′	85° 05′	85° 10′	85° 08′
32	38	60	60	00	03	15	05
84° 42′				85° 06′			

84° 54′

Dip by needle II, 84° 58′

RECAPITULATION OF RESULTS FOR DIP AT PORT FOULKE, July 4–7, 1861

No.	Needle.	Dip.	
Set 1	II	85° 00′	
" 2	III	85 05	
" 3	II	85 01	Resulting mean dip, 85° 02′
" 4	III	85 08	
" 5	II	84 58	

Littleton Island, SMITH STRAIT. July 26 P. M.

Set 1. Needle II, marked end North.

E.				W.			
E.		W.		E.		W.	
85° 15′	85° 10′	84° 20′	84° 20′	84° 40′	84° 45′	84° 25′	84° 30′
20	20	25	25	63	55	30	30
84° 49′				84° 40′			

84° 44′

Needle II, marked end South.

W.				E.			
W.		E.		W.		E.	
84° 15′	84° 10′	84° 40′	84° 45′	84° 52′	84° 50′	84° 60′	85° 05′
15	15	40	45	60	52	55	00
84° 28′				84° 56′			

84° 42′

Dip by needle II, 84° 43′

Set 2. Needle III, marked end South.

	E.	E.	W.		E.	W.	W.
84° 48′	84° 48′	84° 35′	84° 35′	84° 15′	84° 10′	84° 40′	84° 40′
48	48	42	42	22	22	30	30
	84° 43′				84° 26′		
			84° 35′				

Needle III, marked end North.

	W.	W.	E.		W.	E.	E.
84° 22′	84° 15′	84° 30′	84° 30′	85° 05′	85° 05′	85° 00′	85° 05
30	30	40	45	15	15	10	15
	84° 30′				85° 08′		
			84° 49′				

Dip by needle III, 84° 42′

Recapitulation of Results for Dip at Littleton Island, July 26, 1861

	Needle.	Dip.	
Set 1	II	84° 43′	
" 2	III	84 42	Resulting mean dip, 84° 43′

Gale Point, Cadogan Inlet, Smith Strait, July 28, 1861.

Set 1. Needle III, marked end South.

	W.	W.	E.		W.	E	E.
85° 07′	85° 00′	85° 15′	85° 20′	85° 45′	85° 35′	85° 15′	85° 20′
00	03	18	20	45	35	07	10
	85° 10′				85° 26′		
			85° 18′				

Needle III, marked end North.

	E.	E.	W.		E.	W.	W.
85° 35′	85° 30′	85° 05′	85° 10′	85° 35′	85° 40′	85° 15′	85° 15′
45	40	20	15	30	30	10	15
	85° 25′				85° 24′		
			85° 24′				

Dip by needle III, 85° 21′

Hakluyt Island, off Whale Sound. August 2 A. M., 1861.

Set 1. Needle II, marked end South.

	E.	E.	W.		E.	W.	W.
85° 00′	85° 00′	85° 20′	85° 15′	84° 45′	85° 00′	84° 45′	84° 45′
00	00	25	20	45	00	55	50
	85° 10′				84° 51′		
			85° 00′				

Needle II, marked end North.

	W.	W.	E.		W.	E.	E.
84° 45′	84° 50′	85° 00′	84° 65′	84° 55′	84° 50′	85° 20′	85° 15′
40	45	00	55	65	60	20	15
	84° 53′				85° 07′		
			85° 00′				

Dip by needle II, 85° 00′

Netlik, WHALE SOUND. August 4 P. M., 1861.

Set 1. Needle II, marked end South.

	E.	E.	W.		E.	W.	W.
84° 50′	84° 55′	84° 55′	84° 55′	84° 60′	85° 00′	84° 45′	84° 45′
60	60	60	60	50	00	40	40

84° 57′ 84° 50′

84° 53′

Needle II, marked end North.

	W.	W.	E.		W.	E.	E.
84° 30′	84° 40′	85° 15′	85° 15′	84° 65′	84° 60′	85 25′	85° 15′
30	30	30	30	50	50	25	20

84° 57′ 85° 09′

85° 03′

Dip by needle II, 84° 58′

Godhavn, DISCO ISLAND, GREENLAND. August 31, 1861

In garden at the rear of Inspector's house.

Set 1. Needle II, marked end South.

	E.	E.	W.		E.	W.	W.
81° 60′	81° 55′	81° 30′	81° 30′	82° 12′	82° 12′	81° 45′	81° 45′
45	37	30	30	00	00	30	30

31° 40′ 81° 52′

81° 46′

Needle II, marked end North.

	W.	W.	E.		W.	E.	E.
81° 42′	81° 42′	81° 30′	31° 30′	82° 15′	81° 70′	82° 00′	82° 15′
45	45	37	45	00	45	00	00

81° 40′ 82° 03′

81° 51′

Dip by needle II, 81° 49′

Set 2. Needle III, marked end South. September 13, 1861.

	E.	E.	W.		E.	W.	W.
81° 45′	81° 40′	81° 45′	81° 40′	81° 35′	81° 32′	81° 45′	81° 50′
45	40	45	40	45	45	45	50

81° 42′ 81° 43′

81° 43′

Needle III, marked end North.

	W.	W.	E.		W.	E.	E.
82° 00′	82° 00′	81° 45′	81° 50′	82° 15′	82° 15′	81° 75′	82° 15′
05	15	50	60	18	15′	50	00

81° 58′ 82° 10′

82° 04′

Dip by needle III, 81° 53′

RECAPITULATION OF RESULTS FOR DIP AT GODHAVN.

August 31, and September 13, 1861.

No.	Needle.	Dip.	
Set 1	II	81° 49′	
" 2	III	81 53	Resulting mean dip, 81° 51′

RECAPITULATION OF OBSERVED DIPS. Observations by H. G. Radcliff.

No.	Locality.	Latitude.	Longitude.	Dip.	Date.
1	Port Foulke, Smith Strait	78° 18′	73° 00′	85° 02′	July, 1861
2	Littleton Island, Smith Strait . .	78 22	73 30	84 43	" "
3	Gale Point Cadogan Inlet	78 11	76 28	85 21	" "
4	Hakluyt Island, off Whale Sound .	77 23	73 10	85 00	August, 1861
5	Netlik, Whale Sound	77 08	71 22	84 58	" "
6	Godhavn, Disco Island, Greenland .	69 12	53 28	81 51	Aug. and Sept. 1861

To the above material available for the construction of an isoclinal chart of the vicinity of Smith Strait, I have added the following three determinations from Dr. Kane's expedition: Cape Grinnell,[1] latitude 78° 34′, longitude, 71° 34′, dip 85° 08′ in August, 1853. Marshall Bay,[2] latitude 78° 51′, longitude 68° 54′, dip 84° 49′ in September, 1853. Van Rensselaer Harbor, latitude 78° 37′, longitude 70° 53′, dip 84° 46′ in June, 1854.

The observed inclination I at these eight stations is represented by the equation—

$$I = 84^\circ.97 - 0.09\ \Delta\phi + 0.12\ \Delta\lambda \cos\phi$$

$$\text{where } \Delta\phi = \phi - 78^\circ.18 \text{ and } \Delta\lambda = \lambda - 72^\circ.36$$

The isoclinal lines on the chart were computed by the above formula; as in the case of the declinations and horizontal force determinations, the effect of the secular change between the interval of the two expeditions has been neglected.

The observations are represented as follows:—

	Observed I.	Computed I.	Difference.
Port Foulke	85.°03	84°.98	+0. 05
Littleton Island	84.72	84.98	—0.26
Gale Point	85.35	85.07	+0.28
Hakluyt Island	85.00	85.06	—0.06
Netlik	84.97	85.04	—0.07
Cape Grinnell	85.13	84.92	+0.21
Marshall Bay	84.82	84.83	—0.01
Van Rensselaer Harbor	84.77	84.90	—0.13

The probable error of any single representation is $\pm 0^\circ.13$, and of the resulting lines $\pm 0^\circ.05$ nearly.

The chart embodies the collective results for magnetic distribution at and near Smith Strait by the two American Polar Expeditions, and the years 1861, 1858, and 1858, may be taken for the respective epochs to which the graphical represen-

[1] Called "Bedevilled Reach" in the magnetic paper, and in the original record; it apparently comprised the coast between Capes Inglefield and Ingersoll. See chart in Vol. I of his narrative. See also Smithsonian Contributions to Knowledge: Magnetical Observations in the Arctic Seas, by E. K. Kane, M. D., U. S. N., etc. etc., reduced and discussed by C. A. Schott, p. 35 (published in November, 1858). The longitude has been slightly improved.

[2] For latitude and longitude see Astronomical Observations in the Arctic Seas, by E. K. Kane, M. D., U. S. N., etc. etc., reduced and discussed by C. A. Schott, p. 41, Smithsonian Contributions to Knowledge (May, 1860).

tations of the distribution of the declination, horizontal force, and inclination more strictly refer. The necessary use of systems of straight lines forbids their extension beyond the area marked out by the position of the observing stations.

Remarks on Observations of the Aurora Borealis.

It is a remarkable fact that during the winter 1860–1861 but three auroras were seen and recorded, and these were feeble and short displays. Possibly some more may have occurred, but they were too faint to be recognized.

The following notices are extracted from the records:—

"January 6, 1861. 11 A.M. Red aurora seen in the north, extending from horizon to zenith; lasted about 15 minutes. $7^h\ 5^m$ P.M. Aurora seen extending from N. to S. about 30°; lasted nearly half an hour. 9 P.M. Aurora seen the same as $7^h\ 45^m$, about 10 degrees nearer the horizon.

"January 11. Heavy mist hanging over the ice all day. 3 P.M. Aurora observed in the west; extended to the zenith; lasted about 10 minutes.

"February 16. An aurora visible at 9 P.M. in the west; lasted about 10 minutes; 25° to 30° high."

The direction in which the last two auroras were seen coincides in general with the direction of the north end of the magnetic needle, and with the position of an area of open water, present throughout the winter, and extending within a few miles to Port Foulke. This last remark may be of interest to those who are inclined to consider a large area of rising vapor as a favorable circumstance for the appearance of the aurora.[1] The noted paucity of auroral displays is unfavorable to the hypothesis of the coincidence of a maximum frequency with that of the solar spots, the greatest range of diurnal motion in the horizontal magnetic needle and the greatest number of magnetic disturbances, for all of which latter phenomena the years 1860–1861 include or approach the maximum value.

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[1] Meteorological Observations in the Arctic Seas, by Sir Francis Leopold M'Clintock, R. N., 1857–58–59. Smithsonian Contributions to Knowledge, May, 1862. Tabulation of auroras, with observations and notes by Dr. D. Walker.

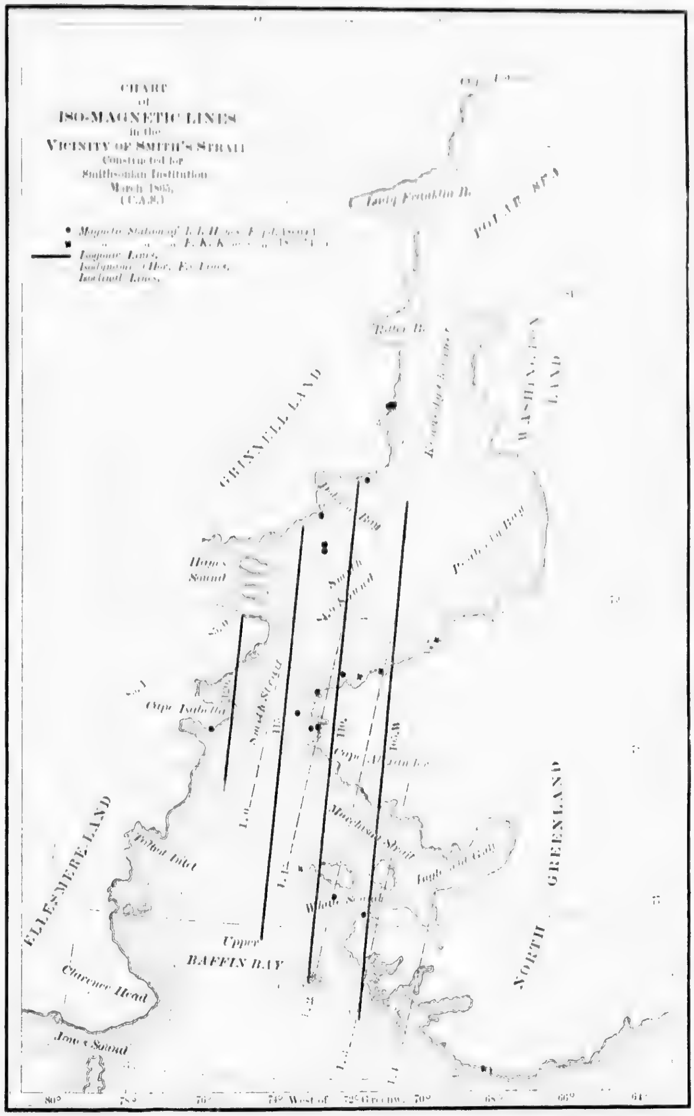


CHART
of
ISO-MAGNETIC LINES
in the
VICINITY OF SMITH'S STRAIT
Constructed for
Smithsonian Institution
March 1865.
(C.A.S.)
Isogonic Lines.
Isodynamic (Hor. F.) Lines.
Inclinal Lines.
Lady Franklin B.
POLAR SEA
GRINNELL LAND
WASHINGTON LAND
Hayes Sound
Cape Isabella
Smith Strait
Smith Sound
Murchison Strait
ELLESMERE LAND
Talbot Inlet
Whale Sound
Upper
BAFFIN BAY
Clarence Head
Jones Sound
NORTH GREENLAND
West of
Greenw.

PART III.

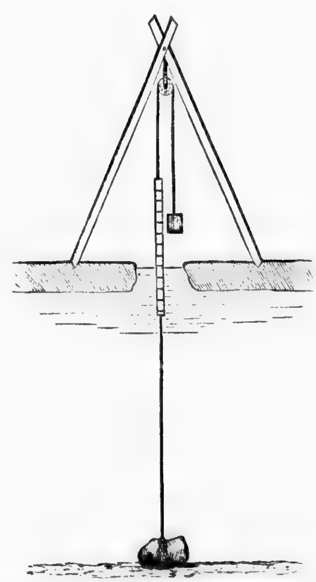
TIDAL OBSERVATIONS.

RECORD AND RESULTS

OF

TIDAL OBSERVATIONS.

THE observations of the tides made by the Arctic Expedition of Dr. I. I. Hayes, at Port Foulke, Smith Strait, in 1860 and 1861, consist of two series; in the first are recorded the observed times and heights of high and low water in November and December, 1860, the greater part of it comprising half-hourly observations. The second series consists of observations of time and height of high and low water in June and July, 1861. These observations were taken every ten minutes about the time of high and low tide. The total extent of these two sets of observations is nearly two and a half months; a few accidental interruptions, however, occur in each series.



The tide gauge was of simple and effective construction, as shown in the annexed wood cut. It was a pulley gauge mounted upon the ice field in the harbor. The pulley and rope were supported by a tripod mounted over the hole cut through the ice; the tide rope was anchored at the bottom, and, in the first series, was divided off in feet by proper marks; in the second series a pole was inserted upon which the scale of feet was marked. The tide-rope was kept stretched by a counterpoise; this weight rose and fell with the tide. A gauge of such construction may be liable to disarrangement from the following sources: the rope may stretch, or the ice-field may have a slow motion and consequently incline the rope, or the stone may drag along the sloping bottom from the effects of currents or ice motion; if, from any cause, the apparatus fails, the zero level of the scale is easily lost, and generally cannot be recovered.

Sources of error in our observations have been specially examined, and such corrections as were found necessary have been applied. The results show the careful and conscientious manner in which these observations were made. For comparison with the results at Van Rensselaer Harbor[1] from Dr. Kane's observations in 1853 and 1854, the reductions are made on a uniform plan, as far as practicable, and in each case special reference is given.

Respecting the free access of the tide wave to the place of observation, the locality was suitably selected (see the small chart accompanying the discussion of the astronomical observations, Part I of this series). The apparatus was mounted in close vicinity to the brig, near the head of the port.

The observers, Messrs. H. G. Radcliff, G. F. Knorr, and C. C. Starr, are indicated, in the record, by their initials.

Record of Tide Observations at Port Foulke, Smith Strait.

First Series. 1860.

Nov. 17 P. M.			
H. W.			
1^{h}	10^{m}	$18^{ft.}$	$11^{in.}$
2	00	19	2
2	30	19	3
3	00	18	11
3	30	18	0
L. W.			
7	00	10	0
8	00	10	0
8	30	9	10
9	00	9	9
9	30	9	11
10	30	10	8
Nov. 18 A. M.			
H. W.			
2	00	15	6
2	40	16	0
3^{h}	00^{m}	$16^{ft.}$	$0^{in.}$
3	20	15	7
L. W.			
9	00	11	11
9	30	11	4
9	55	11	10
P. M.			
H. W.			
3	00	18	2
3	20	18	3
3	40	18	1
4	00	17	11
L. W.			
7	30	12	0
8	00	11	0
8	35	11	0
9	00	10	11
9^{h}	35^{m}	$10^{ft.}$	$6^{in.}$
10	00	10	1
10	20	10	7
Nov. 19 A. M.			
H. W.			
Not recorded			
L. W.			
Not recorded			
P. M.[2]			
H. W.			
3	15	14	0
4	00	14	6
4	30	14	9
5	00	14	6
5	30	13	11
6	00	13	1
7^{h}	00^{m}	$11^{ft.}$	$11^{in.}$
8	00	10	8
L. W.			
9	20	8	3
9	55	8	0
10	15	7	9
11	00	8	0
12	00	8	3
1	00	9	3
2	10	10	6
Nov. 20 A. M.			
H. W.			
3	00	11	3
4	00	12	0
5	00	12	0
5	15	11	11
L. W.			
Not recorded			
P. M.			
H. W.			
Not recorded			
L. W.			
9^{h}	15^{m}	$9^{ft.}$	$9^{in.}$
9	30	9	7
10	00	9	0
10	45	8	1
11	00	8	2
11	20	8	5
Nov. 21 A. M.			
H. W.			
Not recorded			

[1] Tidal observations in the Arctic Seas, by E. K. Kane, M. D., U. S. N.; made during the second Grinnell Expedition in 1853–54–55, at Van Rensselaer Harbor. Reduced and discussed by Charles A. Schott. Smithsonian Contributions to Knowledge, Vol. XIII, 1860.

[2] Between November 19 (P. M.) and December 10, inclusive, the new tide rope was used.

November, 1860.										
Mean time. A. M.	21st	22d	23d	24th	25th	26th	27th	28th	29th	30th
0h 30m	- - - -	7ft 9in	8ft 6in	9ft 00in	- - - -	9ft 4in	12ft 3in	13ft 0in	13ft 9in	18ft 8in
1	- - - -	7 11	8 2	8 1	- - - -	8 6	11 0	12 0	12 8	17 11
1 30	- - - -	8 1	8 2	8 0	- - - -	7 8	9 10	11 1	11 9	16 6
2	- - - -	8 4	8 3	7 8	- - - -	7 6	9 0	10 2	10 10	15 8
2 30	- - - -	8 8	8 4	7 8	- - - -	7 0	8 2	9 0	9 5	14 5
3	- - - -	9 9	8 11	7 10	- - - -	6 8	7 0	8 1	8 8	13 1
3 30	- - - -	10 5	9 4	8 0	- - - -	6 7	6 8	7 2	7 6	12 0
4	- - - -	11 1	9 9	8 2	- - - -	7 6	6 6	6 11	7 0	11 0
4 30	- - - -	11 0	10 4	9 0	- - - -	7 11	6 8	5 8	6 0	10 2
5	- - - -	(10 1)	11 2	9 8	- - - -	8 9	7 6	6 0	6 0	9 10
5 30	- - - -	11 6	12 1	10 11	- - - -	9 10	8 0	7 0	6 3	9 4
6	- - - -	12 10	13 0	12 0	- - - -	10 9	9 0	8 0	7 0	9 8
6 30	- - - -	13 00	13 7	12 9	- - - -	11 11	10 3	8 9	8 0	10 0
7	- - - -	13 4	14 0	13 4	- - - -	12 7	11 8	10 0	8 3	10 6
7 30	- - - -	13 5	14 2	14 6	- - - -	13 10	12 10	11 8	8 8	11 10
8	- - - -	13 2	14 3	15 0	- - - -	14 3	14 0	12 9	9 2	12 3
8 30	11ft 0in	12 11	- - - -	15 2	- - - -	15 0	15 10	14 0	12 2	14 5
9	10 10	12 7	14 0	15 4	- - - -	15 2	16 5	15 8	14 0	16 0
9 30	10 8	12 3	13 10	15 7	- - - -	15 4	17 3	16 7	16 0	17 4
10	- - - -	11 8	13 8	15 1	- - - -	15 7	17 8	17 11	17 0	18 9
10 30	10 0	11 4	12 11	14 1	- - - -	15 3	18 0	18 3	18 0	20 0
11	9 10	11 0	12 4	13 10	- - - -	- - - -	17 8	18 5	18 7	20 9
11 30	9 9	10 7	11 10	13 5	- - - -	- - - -	17 0	18 4	20 2	21 2
12	9 9	10 0	11 0	12 0	- - - -	- - - -	16 6	17 10	20 0	21 4
Observers:	- - - -	- - - -	K. ½ to 4	S. ½ to 4	- - - -	K. ½ to 4	K. ½ to 4	S. ½ to 4	R. ½ to 4	K. ½ to 4
"	- - - -	- - - -	S. 4½ to 8	K. 4½ to 8	- - - -	S. 4½ to 8	S. 4½ to 8	R. 4½ to 8	K. 4½ to 8	S. 4½ to 8
"	- - - -	- - - -	K.	S.	- - - -	R.	R.	K.	S.	R.

Mean time. P. M.	November, 1860.									
	21st	22d	23d	24th	25th	26th	27th	28th	29th	30th
0^h 30^m	10^{ft} 1^{in}	9^{ft} 9^{in}	10^{ft} 3^{in}	11^{ft} 0^{in}	- - - -	14^{ft} 0^{in}	15^{ft} 8^{in}	17^{ft} 0^{in}	19^{ft} 8^{in}	21^{ft} 4^{in}
1	10 4	9 11	10 0	10 8	- - - -	13 2	14 10	16 2	19 6	21 0
1 30	10 7	10 0	9 10	10 0	- - - -	12 1	13 8	15 0	18 6	20 4
2	11 1	10 1	9 9	9 1	- - - -	10 9	12 1	13 8	17 0	19 6
2 30	11 10	10 3	9 7	8 10	- - - -	9 9	10 10	12 1	16 3	18 11
3	12 0	11 0	9 8	8 10	- - - -	8 8	9 5	11 0	15 0	17 10
3 30	13 1	11 10	10 0	8 9	- - - -	8 0	9 0	9 1	13 8	16 1
4	13 2	12 0	10 4	9 0	- - - -	7 8	8 0	8 7	12 6	14 5
4 30	13 2	12 10	10 11	9 9	- - - -	7 7	7 8	8 0	11 6	13 0
5	13 3	13 0	11 7	10 0	- - - -	8 0	7 9	7 6	10 6	11 10
5 30	13 4	13 3	10 11	10 11	- - - -	8 10	7 10	7 0	10 0	11 0
6	13 1	13 10	10 2	11 2	- - - -	9 9	8 2	7 4	9 10	10 3
6 30	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	9 0	7 9	9 10	10 0
7	13 1	14 0	13 11	13 0	- - - -	11 0	9 8	8 4	9 9	10 4
7 30	12 10	14 0	14 0	13 7	- - - -	12 0	10 5	9 0	11 0	11 0
8	12 2	13 6	13 10	14 1	- - - -	12 10	11 6	10 4	11 10	11 8
8 30	11 10	13 0	13 8	14 0	- - - -	13 5	12 6	11 0	13 0	12 4
9	11 0	12 9	13 0	13 10	- - - -	14 1	13 9	12 5	13 8	13 2
9 30	10 4	12 3	12 8	13 9	- - - -	14 7	14 4	13 2	15 0	14 0
10	10 0	11 7	11 4	13 0	- - - -	14 10	14 8	14 0	16 0	15 4
10 30	9 7	11 0	11 7	12 1	- - - -	14 5	15 0	14 7	16 8	16 0
11	8 8	10 5	10 8	11 9	- - - -	14 0	15 0	14 9	17 5	16 8
11 30	8 0	9 8	10 0	11 0	- - - -	12 3	14 10	14 4	18 0	17 0
12	7 10	9 0	9 3	10 0	- - - -	10 10	14 0	14 1	18 0	17 6
Observers:	- - - -	K. $8\frac{1}{2}$ to 12	S. $\frac{1}{2}$ to 4	K. $\frac{1}{2}$ to 4	- - - -	K. $\frac{1}{2}$ to 4	K. $\frac{1}{2}$ to $3\frac{1}{2}$	S. $\frac{1}{2}$ to 4	R. $\frac{1}{2}$ to 4	K. $\frac{1}{2}$ to 4
"	- - - -	- - - -	K. $4\frac{1}{2}$ to 6	S. $4\frac{1}{2}$ to 6	- - - -	S. $4\frac{1}{2}$ to 8	S. 4 to $5\frac{1}{2}$	R. $4\frac{1}{2}$ to $6\frac{1}{2}$	K. $4\frac{1}{2}$ to 6	S. 4 to 8
"	- - - -	- - - -	S. 7 to 8	K. 7 to 8	- - - -	R.	R. 6 to $7\frac{1}{2}$	K. $6\frac{1}{2}$ to 8	S. $6\frac{1}{2}$ to 9	K.
"	- - - -	- - - -	K.	S.	- - - -	- - - -	K.	S.	R.	- - - -

December, 1860.									
Mean time. A. M.	1st	2d	3d	4th[1]	5th	6th	7th	8th	9th
0h 30m	17ft 9in	16ft 9in	16ft 0in	16ft 0in	13ft 8in	12ft 0in	12ft 0in	10ft 0in	11ft 11in
1	17 10	17 4	16 3	16 0	14 3	13 2	12 2	10 9	10 11
1 30	17 1	17 0	16 6	16 0	15 0	14 0	12 4	11 0	10 7
2	16 4	16 6	17 0	16 0	16 0	14 11	13 6	11 6	9 7
2 30	15 1	15 10	16 10	16 2	16 6	15 8	13 9	12 3	9 4
3	14 3	14 8	16 7	16 2	17 0	16 4	14 3	13 0	9 0
3 30	13 0	14 0	15 0	16 2	17 6	17 2	14 10	13 10	9 5
4	12 3	13 6	14 0	16 0	17 5	18 9	16 0	14 2	10 1
4 30	11 8	12 0	13 8	15 9	18 0	18 11	16 10	16 0	14 0
5	10 2	11 0	12 10	14 6	17 3	19 1	17 6	16 10	14 4
5 30	10 0	10 1	12 0	13 9	16 10	18 10	17 10	17 8	16 5
6	9 8	9 9	11 3	13 0	16 4	18 3	18 0	18 5	17 10
6 30	9 6	9 5	10 2	12 6	15 7	17 9	18 0	19 0	18 3
7	9 9	9 5	10 0	11 9	14 9	16 10	18 2	19 5	19 0
7 30	10 4	9 8	9 10	11 0	14 3	16 0	18 0	19 8	19 5
8	11 0	10 0	10 2	10 5	13 10	15 10	17 8	19 2	19 10
8 30	12 8	11 1	10 6	10 6	13 6	15 0	17 6	19 7	20 0
9	14 0	12 0	10 10	11 0	13 5	14 2	16 9	19 8	20 0
9 30	15 8	13 2	11 10	14 0	13 0	14 4	16 3	19 0	19 4
10	17 0	14 1	13 3	- - - -	12 11	13 10	15 9	18 1	19 0
10 30	18 0	15 10	14 7	- - - -	13 2	13 5	15 0	17 2	18 6
11	19 0	17 0	15 10	13 4	13 10	13 6	14 5	16 0	18 0
11 30	20 0	18 1	16 6	15 2	14 2	13 6	13 11	15 8	16 6
12	20 6	19 0	17 5	17 4	15 0	13 10	13 9	14 3	15 6
Observers:	S. ½ to 4	R. ½ to 4	K. ½ to 4	S. ¼ to 4	R. ½ to 4	S. 4½ to 8	S. ½ to 4	R. ½ to 4	K. ½ to 4½
"	R. 4½ to 8	K. 4½ to 3	S. 4½ to 8	R. 4½ to 8	K. 4½ to 8	R. 8½ to 12	R. 4½ to 8	K. 4½ to 8	S. 5 to 8
"	K.	S.	R.	K.	S.			S.	R.

[1] Between 2½ and 9½ the tide rope was foul of the specimen rope; at 10½ it was taken up, repaired, and put down again.

December, 1860.									
Mean time. P. M.	1st	2d	3d	4th	5th	6th	7th	8th	9th
0^h 30^m	20^{ft} 8^{in}	20^{ft} 0^{in}	18^{ft} 5^{in}	18^{ft} 0^{in}	16^{ft} 0^{in}	14^{ft} 1^{in}	13^{ft} 8^{in}	13^{ft} 5^{in}	15^{ft} 0^{in}
1	20 9	20 2	19 0	19 0	16 5	14 6	13 10	13 0	14 0
1 30	20 4	20 4	19 6	19 7	17 0	15 7	14 0	12 10	13 1
2	19 8	20 2	19 0	20 0	18 0	16 4	15 2	12 10	11 7
2 30	19 0	20 0	18 6	20 2	18 6	17 1	15 4	13 0	10 0
3	18 4	19 2	17 8	20 3	19 0	17 9	16 0	13 6	10 11
3 30	17 0	18 0	17 0	20 2	19 0	18 4	16 7	14 0	12 0
4	16 0	17 3	17 0	20 0	19 6	18 6	17 0	14 7	13 0
4 30	14 0	16 0	16 11	19 8	- - - -	19 1	17 6	15 8	13 9
5	12 10	14 11	16 0	19 0	19 6	19 1	17 10	16 4	14 0
5 30	[illegible] 0	13 6	15 1	18 0	19 4	19 2	18 0	17 0	15 1
6	[illegible] 8	12 0	13 10	17 3	18 4	19 0	18 2	17 10	16 0
6 30	10 0	11 1	12 6	16 0	17 9	18 0	19 0	18 0	17 2
7	9 10	10 1	11 0	14 11	16 10	17 6	18 10	19 0	17 6
7 30	9 8	9 9	10 3	14 0	15 0	16 10	18 0	19 0	17 8
8	9 6	9 3	9 4	13 2	14 0	16 0	17 10	18 10	17 10
8 30	10 0	9 6	9 9	12 1	13 0	15 1	17 1	18 0	18 0
9	10 5	10 0	9 11	11 10	12 3	14 2	16 2	17 4	18 0
9 30	11 10	10 5	10 4	11 6	11 6	13 4	15 8	16 8	17 9
10	12 4	11 0	11 0	11 0	11 0	12 0	14 0	15 10	- - - -
10 30	13 10	12 0	12 4	11 0	10 10	10 11	13 8	15 0	- - - -
11	14 6	12 10	13 6	12 0	10 10	9 8	12 11	14 0	- - - -
11 30	15 10	14 0	14 6	12 6	11 0	9 9	12 0	13 0	- - - -
12	16 0	14 11	15 2	13 0	11 9	10 10	11 8	12 0	- - - -
Observers:	S. ½ to 4	R. ½ to 4	K. ½ to 4	S. ½ to 4	R. ½ to 4	K. ½ to 4	S. ½ to 4	R. ½ to 4	K. ½ to 4
"	R. 4½ to 6	K. 4½ to 6	S. 4½ to 6	R. 4½ to 6	K. 4½ to 6	S. 4½ to 6	R. 4½ to 6	K. 4½ to 6	S. 4½ to 6
"	K. 6½ to 8	S. 6½ to 8	R. 6½ to 8	S. 8½ to 12	S. 6½ to 8½	R. 6½ to 8	K. 6½ to 8	S. 6½ to 8	R. 6½ to 8
"	S.	R.	K.		R.	K.	S.	R.	K.

December, 1860.

10th A. M.

L. W.

2h	00m	10ft	0in
2	30	9	11
3		10	2

S.

H. W.

8		19	6
8	30	20	0
9		21	0
9	30	21	0
10		20	6
10	30	20	0

R.

P. M.

L. W.

2	30	12	6
3		12	0
3	30	12	0
4		12	4

K.

Tide rope taken up and remarked, and put down again.

H. W.

Not observed

11th A. M.

L. W.

Not observed

H. W.

Not observed

P. M.

L. W.

3	30	13	1
4		12	9
4	30	12	1
5		12	6
5	30	12	11
6		13	1

S.

H. W.

9	30	19	0
10		19	6
10	30	19	9
11		19	6
11	30	19	0

R.

12th A. M.

L. W.

4h	00m	11ft	6in
4	30	11	5
5		11	10

K.

H. W.

10		22	0
10	30	22	9
11		23	0
11	30	22	10
12		22	2

S.

P. M.

L. W.

4		12	6
4	30	12	2
5		11	11
5	30	11	11
6		12	0
6	30	12	4

R.

H. W.

10	30	19	5
11		19	8
11	30	19	8
12		19	2

K.

13th A. M.

L. W.

4	30	11	4
5		11	0
5	30	11	4

R.

H. W.

11		23	0
11	30	23	0
12		22	11
12	30	22	8

S.

P. M.

L. W.

5		12	0
5	30	11	10
6		12	2

K.

H. W.

11	30	19	6
12		19	9
12	30	19	3

R.

14th A. M.

L. W.

5h	30m	11ft	10in
6		11	9
6	30	12	1

S.

P. M.

H. W.

0		23	10
0	30	23	10
1		23	0

K.

L. W.

6		12	0
6	30	11	9
7		11	9
7	30	12	0

R.

15th A. M.

H. W.

0		19	8
0	30	19	9
1		19	9
1	30	19	1

S.

L. W.

6	30	12	0
7		11	10
7	30	12	5

K.

P. M.

H. W.

0	30	22	9
1		23	
1	30	22	9

R.

L. W.

7		12	0
7	30	12	0
8		12	2

S.

16th A. M.

H. W.

1		19	0
1	30	19	2
2		19	2
2	30	18	9

K.

L. W.

7h	00m	12ft	4in
7	30	12	4
8		12	10

R.

P. M.

H. W.

1	30	22	6
2		22	10
2	30	22	1

S.

L. W.

7	30	13	3
8		12	10
8	30	13	0

K.

17th A. M.

H. W.

1	30	19	8
2		19	8
2	30	19	4

R.

L. W.

Incorrectly observed

P. M.

H. W.

2		22	0
2	30	22	1
3		21	8

K.

L. W.

8	30	12	11
9		12	9
9	30	13	0

R.

18th A. M.

H. W.

2	30	18	6
3		18	7
3	30	18	1

S.

L. W.

8	30	14	0
9		13	4
9	30	13	9

K.

P. M.

H. W.

3h	00m	20ft	9in
3	30	20	5
4		20	0

R.

L. W.

9		13	0
9	30	12	11
10		13	1

S.

19th A. M.

H. W.

3		18	0
3	30	18	5
4		18	5
4	30	18	0

K.

L. W.

9	30	14	0
10		14	3
10	30	14	8

R.

P. M

H. W.

3	30	20	2
4		20	0
4	30	19	10

S.

L. W.

9	30	13	7
10		13	4
10	30	13	4
11		13	10

K.

20th A. M.

H. W.

4		17	10
4	30	18	0
5		18	0
5	30	17	10

R.

L. W.

10		15	0
10	30	15	0
11		15	0
11	30	15	2
12		15	10

S.

December, 1860.

P. M.			
H. W.			
4h	30m	18ft	7in
5		18	10
5	30	18	10
6		15	3
K.			
L. W.			
10	30	13	0
11		12	10
11	30	12	11
12		13	3
R.			
21st A. M.			
H. W.			
Not observed			
L. W.			
9	30	15	11
10		15	8
10	30.	15	1
11h	00m	15ft	1in
11	30	15	1
12		15	6
S.			
P. M.			
H. W.			
4		17	10
4	30	18	0
5		18	0
5	30	18	0
6		17	9
R.			
L. W.			
10		14	1
10	30	13	9
11		13	7
11	30	13	3
12		13	3
S.			
22d A. M.			
H. W.			
4	30	17	2
5		17	6
5h	30m	17ft	10in
6		18	1
6	30	18	3
7		18	3
7	30	17	9
K.			
L. W.			
10	30	16	3
11		15	11
11	30	15	7
12		15	2
12	30	15	2
1		15	2
1	30	15	2
2		15	2
2	30	15	7
R.			
P. M.			
H. W.			
4	30	16	4
5		16	9
5	30	17	0
6		17	0
6h	30m	17ft	2in
7		17	4
7	30	17	0
S.			
L. W.			
11	30	14	0
12		13	3
12	30	13	3
1		13	3
1	30	13	3
2		13	10
K.			
23d A. M			
H. W.			
5		16	6
5	30	16	10
6		17	6
6	30	18	0
7		18	3
7	30	18	10
8		19	0
8h	30m	18ft	10in
9		18	9
R.			
L. W.			
11		17	3
11	30	16	9
12		16	0
12	30	15	11
1		15	8
1	30	15	0
2		15	4
S.			
P. M.			
H. W.			
6	30	17	8
7		18	2
7	30	18	3
8		18	2
8	30	17	9
K.			

The rope used November 17 and 18 was measured, and its 36 feet mark was found to be 30 feet 8 inches; a proportionate reduction of the readings, as recorded, is therefore to be made.

A new rope was used between November 19 and December 10; the distances from foot mark to foot mark, along its range, are recorded as follows:—

0 to 1 foot		. . . inches
1	2	10.5
2	3	11.25
3	4	11.12
4	5	10.5
5	6	11.25
6	7	11.5
7	8	10.25
8	9	11.75
9	10	10.
10	11	11.25
11 to 12 feet		11 inches
12	13	10
13	14	11.5
14	15	10.25
15	16	10.5
16	17	11
17	18	13
18	19	9.5
19	20	17.5
20	21	13.75
21	22	13

From the above the following table of corrected measures has been made out:—

Mark on rope.	Corresponding true reading.
0 feet	0.0 feet
1	1.0
2	1.9
3	2.8
4	3.7
5	4.6
6	5.5
7	6.5
8	7.4
9	8.3
10	9.2
11 feet	10.1 feet
12	11.0
13	11.9
14	12.8
15	13.7
16	14.6
17	15.4
18	16.5
19	17.3
20	18.8
21	20.0
22	21.0

This table might be used for correcting all observed heights of the tide between November 19 and December 10; but I thought it preferable to suppose that the rope was at first correctly marked but changed afterwards. An examination of the mean level of the sea indicated a small but somewhat abrupt increase in the reading after the first high water of November 29th, and again a similar increase after the first high water of December 4th; I have therefore applied *no* correction to the readings of the rope between November 19th and November 29th, 2 P. M.; and have applied *half* the correction between the last named date and December 4th, 6 A. M. It seems that the apparatus was not in good working order during the last high tide as the readings for four hours indicate some defect. After December 4, 6 A. M., the full correction was applied. On the 11th of December the rope was taken up and re-marked, and the readings from and after this date must be taken as correct.

To obtain a closer determination than half an hour of the time of high and low tide, the heights were plotted and a curve drawn through the points with a free hand from which the time was made out with an uncertainty generally not exceeding ten minutes.

The times and corresponding heights will be given after the record of series two of observations; see Table I.

Record of Tide observations at Port Foulke, Smith Strait.
Second series. 1861.

June 6 A. M.	
H. W.	
10^h 00^m	$17^{ft}.8$
10	.85
20	.8
30	.75
40	.7
50	.55
R.	
P. M.	
L. W.	
3 00	12.25
10	.05
20	.0
30	11.95
40	.95
50	.9
4 00	.95
10	.95
20	.95
30	12.05
40	.15
50	.2
5 00	.25
10	.3
20	.5
R.	
P. M.	
H. W.	
9 00	19.65
10	.9
20	20.1

9^h 30^m	$20^{ft}.3$
40	.45
50	.6
10 00	.7
10	.75
20	.8
30	.8
40	.8
50	.75
11 00	.65
10	.6
R.	
June 7 A. M.	
L. W.	
3 30	13.1
40	12.8
50	.6
4 00	.45
10	.35
20	.25
30	.15
40	.1
50	.15
5 00	.15
10	.2
20	.25
30	.3
R.	
H. W.	
10 50	18.0
11 00	17.9

11^h 10^m	$17^{ft}.85$
20	.8
30	.65
40	.4
K.	
P. M.	
L. W.	
[illegible] 00	11.55
[illegible]0	.5
[illegible]0	.5
30	.5
40	.5
50	.5
5 00	.9
K.	
H. W.	
9 30	20.5
40	.6
50	.9
10 00	21.0
10	.1
20	.4
30	.5
40	.6
50	.65
11 00	.65
10	.65
20	.65
30	.6
40	.35
K.	

June 8 A. M.	
L. W.	
4^h 10^m	$13^{ft}.0$
20	12.85
30	.75
40	.5
50	.4
5 00	.25
10	.1
20	.05
30	.05
40	.05
50	.05
6 00	.25
K.	
H. W.	
10 00	18.1
10	.
20	.35
30	.5
40	.65
50	.7
11 00	.7
10	.72
20	.7
30	.62
40	.45
S.	
P. M.	
L. W.	
3 30	12.55
40	.38

3^h 50^m	$12^{ft}.1$
4 00	.0
10	11.8
20	.9
30	.6
40	.5
50	.5
5 00	.52
10	.55
20	.6
30	.7
S	
10 00	20.7
10	- - -
20	21.45
30	.6
40	.75
50	.9
11 00	22.0
10	.1
20	.15
30	.2
40	.2
50	.1
12 00	.0
S.	
June 9 A. M.	
L. W.	
4 30	13.3
40	.1
50	12.9

Second series, 1861.—*Continued.*

June 9 A. M.

L. W.

5^h	00^m	$12^{ft}.8$
	10	.15
	20	.4
	30	.15
	40	.1
	50	.0
6	00	.0
	10	.0
	20	.1
	30	.2

S.

H. W.

10	30	18.0
	40	.1
	50	.4
11	00	.55
	10	.65
	20	.7
	30	.8
	40	.8
	50	.75
12	00	.75
	10	.65

R.

P. M.

L. W.

4	10	12.55
	20	.35
	30	.15
	40	.0
	50	....
5	00	11.75
	10	.7
	20	.65
	30	.65
	40	.65
	50	.7
6	00	.75

R.

P. M.

H. W.

11	00	21.6
	10	.8
	20	22.05
	30	.2
	40	.3
	50	.35
12	00	.4
	10	.4
	20	.4
	30	.35
	40	.25

R.

June 10 A. M.

L. W.

5^h	20^m	$12^{ft}.9$
	30	.7
	40	.45
	50	.4
6	00	.3
	10	.05
	20	.0
	30	.0
	40	.0
	50	.0
7	00	.05
	10	.15
	20	.3

R.

H. W.

11	00	18.2
	10	.5
	20	.6
	30	.8
	40	.9
	50	19.0
12	00	.05
	10	.1
	20	.1
	30	.1
	40	.1
	50	18.9

K.

P. M.

L. W.

5	00	12.5
	10	.4
	20	.25
	30	.1
	40	.0
	50	11.9
6	00	.9
	10	.9
	20	.9
	30	.9
	40	12.0
	50	.1

K.

H. W.

11	30	21.9
	40	22.3
	50	.3
0	00	.4
	10	.6
	20	.7
	30	.8
	40	.8

0^h	50^m	$22^{ft}.8$
1	00	.7
	10	.65
	20	.55

K.

June 11 A. M.

L. W.

5	40	13.2
	50	12.9
6	00	.7
	10	.45
	20	.3
	30	.15
	40	.0
	50	11.9
7	00	.9
	10	.9
	20	.9
	30	.9
	40	.95
	50	12.05
8	00	.2

K.

P. M.

H. W.

0	00	18.5
	10	.7
	20	.75
	30	.8
	40	.9
	50	.9
1	00	.9
	10	.85
	20	.8
	30	.75

S.

L. W.

5	30	12.4
	40	.3
	50	.3
6	00	.2
	10	11.95
	20	.9
	30	.9
	40	.9
	50	.9
7	00	.9
	10	12.0
	20	.1
	30	.2

S.

June 12 A. M.

H. W.

0^h	10^m	$21^{ft}.4$
	20	.6
	30	.8
	40	.9
	50	22.1
1	00	.15
	10	.2
	20	.2
	30	.2
	40	.1
	50	.0
2	00	21.9

S.

L. W.

6	30	12.7
	40	.4
	50	.2
7	00	.0
	10	11.9
	20	.75
	30	.7
	40	.6
	50	.6
8	00	.6
	10	.6
	20	.7
	30	.8

S.

P. M.

H. W.

0	30	18.0
	40	.2
	50	.3
1	00	.4
	10	.5
	20	.55
	30	.6
	40	.6
	50	.6
2	00	.55
	10	.5
	20	.35

K.

L. W.

7	00	12.4
	10	.3
	20	.25
	30	.2
	40	.2
	50	.2
8	00	.2

8^h	10^m	$12^{ft}.2$
	20	.4

K.

June 13 A. M.

H. W.

0	40	20.7
	50	.9
1	00	21.2
	10	.35
	20	.5
	30	.6
	40	.7
	50	.7
2	00	.7
	10	.7
	20	.65
	30	.4

K.

L. W.

7	00	12.9
	10	.7
	20	.5
	30	.3
	40	.1
	50	.0
8	00	11.9
	10	.9
	20	12.1
	30	.2

K.

P. M.

H. W.

1	00	17.9
	10	18.1
	20	.2
	30	.35
	40	.45
	50	.6
2	00	.75
	10	.75
	20	.75
	30	.75
	40	.75
	50	.75
3	00	.55
	10	.45

K.

L. W.

7	20	13.4
	30	.25
	40	.2
	50	.15

Second series, 1861.—*Continued*

June 13 P. M.

L. W.

8h	00m	13ft.15
	10	.15
	20	.15
	30	.2
	40	.45

K.

June 14 A. M.

H. W.

1	30	20.7
	40	.9
	50	21.0
2	00	.2
	10	.3
	20	.35
	30	.35
	40	.35
	50	.35
3	00	.35
	10	.3
	20	.25
	30	20.9

K.

L. W.

7	40	13.0
	50	12.9
8	00	.7
	10	.4
	20	.2
	30	.1
	40	.0
	50	11.9
9	00	.9
	10	12.1

K.

P. M.

H. W.

1	50	17.9
2	00	18.0
	10	.15
	20	.3
	30	.4
	40	.5
	50	.6
3	00	.65
	10	.65
	20	.65
	30	.65
	40	.65
	50	.45

K.

L. W.

8	00	13.9
	10	.5
8h	20m	13ft.35
	30	.25
	40	.2
	50	.15
9	00	.1
	10	.05
	20	.05
	30	.1
	40	.3
	50	.4

K.

June 15 A. M.

H. W.

2	10	19.85
	20	20.1
	30	.2
	40	.3
	50	.45
3	00	.5
	10	.55
	20	.55
	30	.55
	40	.55
	50	.55
4	00	.4

K.

L. W.

8	30	12.8
	40	.6
	50	.4
9	00	.2
	10	.0
	20	11.9
	30	.9
	40	.9
	50	.8
10	00	.8
	10	.8
	20	.8
	30	.9
	40	12.0

K.

P. M.

H. W.

2	30	17.8
	40	.9
	50	18.1
3	00	.3
	10	.5
	20	.6
	30	.6
	40	.9
	50	.9
4	00	19.0
	10	.0
	20	.0
4h	30m	19ft.0
	40	18.95
	50	.95
5	00	.8

K.

L. W.

9	00	14.4
	10	.3
	20	.1
	30	.1
	40	.05
	50	.0
10	00	.0
	10	.0
	20	.0
	30	.1

K.

June 16 A. M.

H. W.

2	40	20.2
	50	.4
3	00	.5
	10	.65
	20	.65
	30	.65
	40	.7
	50	.7
4	00	.7
	10	.7
	20	.65
	30	.55
	40	.3

K.

9 30

Pole carried away by a strong S. W. gale

June 17 A. M.

The anchor of the pole was taken up, and the pole repaired and replaced. The bottom is sloping, and the zero point therefore differs from that of the former observations.

P. M.

H. W.

3	40	17.9
	50	18.1
4h	00m	18ft.4
	10	.9
	20	.95
	30	19.2
	40	.4
	50	.7
5	00	.9
	10	20.0
	20	.1
	30	.3
	40	.5
	50	.6
6	00	.6
	10	.75
	20	.75
	30	.75
	40	.6
	50	.4

K.

Strong wind from S. W.

L. W.

10	10	16.0
	20	15.9
	30	.6
	40	.4
	50	.1
11	00	14.9
	10	.8
	20	.5
	30	.4
	40	.3
	50	.3
12	00	.1
	10	.1
	20	.1
	30	.25

K.

Strong wind from S. W.

June 18 A. M

H. W.

6	00	18.7
	10	.8
	20	.9
	30	19.0
	40	.0
	50	.0
7	00	.0
	10	18.8
	20	.5

K.

Strong wind from S. W.

L. W.

10h	30m	13ft.75
	40	.45
	50	.25
11	00	.0
	10	12.9
	20	.8
	30	.75
	40	.7
	50	.6
12	00	.5
	10	.35
	20	.3
	30	.3
	40	.3
	50	.35
1	00	.4
	10	.42
	20	.45

S.

Strong wind from S. W.

P. M.

H. W.

4	30	16.9
	40	17.25
	50	.7
5	00	.95
	10	18.15
	20	.35
	30	.65
	40	19.0
	50	.35
6	00	.5
	10	.7
	20	.8
	30	20.0
	40	.2
	50	.4
7	00	.5
	10	.6
	20	.6
	30	.65
	40	.65
	50	.65
8	00	.6
	10	.5
	20	.4
	30	.3

S.

Strong wind from S. W.

L. W.

11	00	16.6
	10	.4
	20	.1
	30	15.9
	40	.6

Second series, 1861.—*Continued.*

June 18 P. M.

L. W.

11^{h}	50^{m}	$15^{ft}.35$
12	00	.1
	10	14.9
	20	.6
	30	.4
	40	.3
	50	.1
1	00	.05
	10	.0
	20	13.9
	30	.9
	40	.9
	50	.9
2	00	14 .0
	10	.1

S.

Strong wind from S. W.

June 19 A. M.

H. W.

6	30	18.6
	40	.75
	50	.8
7	00	.95
	10	19.0
	20	.05
	30	.1
	40	.1
	50	.0
8	00	.0
	10	18.9
	20	.75

S.

Strong wind from S. W.

P. M.

L. W.

0	00	13.25
	10	.0
	20	12.9
	30	.7
	40	.5
	50	.5
1	00	.45
	10	.4
	20	.3
	30	.4
	40	.45
	50	.5

R.

Strong wind from S. W.

H. W.

6^{h}	30^{m}	$19^{ft}.7$
	40	.9
	50	20.15
7	00	.4
	10	.65
	20	.9
	30	21.05
	40	.2
	50	.35
8	00	.45
	10	.55
	20	.6
	30	.65
	40	.65
	50	.6
9	00	.6
	10	.5

R.

Strong wind from S. W.

L. W.

Not observed

June 20 A. M.

H. W.

7	40	18.65
	50	.75
8	00	.95
	10	.95
	20	19.05
	30	.05
	40	.05
	50	.05
9	00	.0
	10	18.95
	20	.8

- - - - -

P. M.

L. W.

1	00	13.1
	10	12.9
	20	.9
	30	.5
	40	.5
	50	.45
2	00	.45
	10	.45
	20	.45
	30	.45
	40	.45
	50	.6

- - - -

Pole taken up

P. M.

H. W.

8^{h}	00^{m}	$20^{ft}.5$
	10	.7
	20	.9
	30	21.0
	40	.3
	50	.5
9	00	.6
	10	.7
	20	.7
	30	.7
	40	7
	50	.65
10	00	.5

- - - - -

June 21 A. M.

L. W.

1	30	14.7
	40	.3
	50	.1
2	00	13.9
	10	.5
	20	.2
	30	12.9
	40	.6
	50	.5
3	00	.5
	10	.5
	20	.7

- - - - -

H. W.

8	10	17.65
	20	.8
	30	.95
	40	18.2
	50	.25
9	00	.35
	10	.4
	20	.4
	30	.4
	40	.4
	50	.4
10	00	.3
	10	.2

- - - - -

P. M.

L. W.

1	40	12.8
	50	.5
2	00	.3
	10	.0
	20	11.75
	30	.5
	40	.2
	50	.0

3^{h}	00^{m}	$10^{ft}.85$
	10	.55
	20	.5
	30	.4
	40	.3
	50	.3
4	00	.3
	10	.3
	20	.4
	30	.5

- - - - -

H. W.

8	40	20.0
	50	.2
9	00	.55
	10	21.15
	20	.4
	30	.6
	40	.8
	50	22.0
10	00	.05
	10	.1
	20	.1
	30	.1
	40	.1
	50	.1
11	00	.0
	10	21.9

- - - - -

June 22 A. M.

L. W.

5	00	11.3
	10	.1
	20	.1
	30	.1
	40	.2
	50	.3
6	00	.3

- - - - -

H. W.

11	00	18.7
	10	.6
	20	.5

- - - - -

P. M.

L. W.

4	30	10.6
	40	- - -
	50	.5
5	00	.5
	10	.5
	20	.7
	30	.8

- - - - -

H. W.

10^{h}	40^{m}	$22^{ft}.5$
	50	.6
11	00	.6
	10	.7
	20	.7
	30	.7
	40	.6
	50	.5

- - - - -

June 23 A. M.

L. W.

4	30	11.9
	40	.6
	50	.3
5	00	.2
	10	.0
	20	10.85
	30	.8
	40	.7
	50	.7
6	00	.7
	10	.8
	20	.85
	30	.9

S.

H. W.

10	50	18.6
11	00	.8
	10	.85
	20	19.0
	30	.0
	40	.0
	50	.0
12	00	18.9
	10	.7

S.

P. M.

L. W.

4	50	10.6
5	00	.5
	10	.35
	20	.35
	30	.35
	40	.4
	50	.5
6	00	.6

S.

H. W.

10	50	21.85
11	00	22.05
	10	.3
	20	.45
	30	.6
	40	.7

Second series, 1861.—*Continued.*

June 23 P. M.		
H. W.		
11^{h}	50^{m}	$22^{ft}.75$
0	00	.75
	10	.75
- - - -	- - - -	- - - -
1	20	.1
S.		
June 24 A. M.		
L. W.		
5	30	11.1
	40	.0
	50	10.85
6	00	.8
	10	.7
	20	.6
	30	.6
	40	.6
	50	.6
7	00	.6
	10	.7
	20	.9
S.		
H. W.		
11	10	18.25
	20	.5
	30	.7
	40	.9
	50	19.0
12	00	.1
	10	.2
	20	.2
	30	.2
	40	.1
	50	.0
1	00	18.9
S.		
P. M.		
L. W.		
5	10	11.35
	20	.2
	30	10.95
	40	.9
	50	.8
6	00	.8
	10	.8
	20	.85
	30	.9
	40	11.0
S.		
H. W.		
11	00	20.9
	10	21.3
	20	.65
	30	22.0
11^{h}	40^{m}	$22^{ft}.2$
	50	.3
12	00	.5
	10	.7
	20	.8
	30	.9
	40	.9
	50	.9
1	00	.8
	10	.7
S.		
June 25 A. M.		
L. W.		
6	20	11.2
	30	.0
	40	10.9
	50	.8
7	00	.7
	10	.7
	20	.7
	30	.85
	40	.95
S.		
H. W.		
11	30	17.8
	40	...
	50	18.25
12	00	.5
	10	.7
	20	.8
	30	19.05
	40	.2
	50	.2
1	00	.25
	10	.25
	20	.2
	30	.2
	40	.1
	50	18.95
R.		
Heavy gale from S. W.		
P. M.		
L. W.		
5	50	11.9
6	00	.8
	10	.6
	20	.5
	30	.4
	40	.3
	50	.3
7	00	.3
	10	.3
	20	.4
	30	.55
R.		
Heavy gale from S. W.		
June 26 A. M.		
H. W.		
0^{h}	00^{m}	$21^{ft}.4$
	10	.65
	20	.9
	30	22.0
	40	.2
	50	.35
1	00	.4
	10	.5
	20	.6
	30	.6
	40	.55
	50	.4
R.		
Heavy gale from S. W.		
L. W.		
6	10	12.9
	20	.55
	30	.3
	40	11.9
	50	.8
7	00	.5
	10	.5
	20	.3
	30	.3
	40	.05
	50	.05
8	00	.1
	10	.1
	20	.2
	30	.2
	40	.3
	50	.4
R.		
Heavy gale from S. W.		
P. M.		
H. W.		
0	30	18.1
	40	.2
	50	.4
1	00	.7
	10	.7
	20	.8
	30	.9
	40	19.0
	50	.0
2	00	.0
	10	.0
	20	.0
	30	18.8
K.		
Heavy wind		
L. W.		
6	30	12.5
	40	.3
6^{h}	50^{m}	$12^{ft}.1$
7	00	.0
	10	.0
	20	.0
	30	11.8
	40	.8
	50	.8
8	00	12.1
K.		
Heavy wind.		
June 27 A. M.		
H. W.		
1	00	21.4
	10	.5
	20	.6
	30	.7
	40	.9
	50	.9
2	00	.9
	10	22.0
	20	.0
	30	21.8
K.		
Strong wind.		
L. W.		
7	10	12.4
	20	.1
	30	11.9
	40	.7
	50	.7
8	00	.5
	10	.5
	20	.4
	30	.4
	40	.4
	50	.4
9	00	.4
	10	.4
	20	.7
K.		
P. M		
H. W.		
1	00	17.9
	10	18.0
	20	.2
	30	.3
	40	.5
	50	.65
2	00	.7
	10	.8
	20	.85
	30	.9
	40	.9
	50	.9
3	00	.75
S.		
L. W.		
7^{h}	00^{m}	$13^{ft}.25$
	10	.1
	20	12.95
	30	.8
	40	.7
	50	.6
8	00	.....
	10	.6
	20	.6
	30	.6
	40	.7
	50	.75
9	00	.9
S.		
June 28 A. M.		
H. W.		
1	30	20.4
	40	.7
	50	.9
2	00	21.0
	10	.1
	20	.1
	30	.1
	40	.1
	50	.05
3	00	20.95
S.		
L. W.		
7	30	13.0
	40	12.8
	50	.6
8	00	.35
	10	.1
	20	.0
	30	11.9
	40	.8
	50	.8
9	00	.8
	10	.8
	20	.8
	30	.8
	40	.9
	50	12.0
S.		
P. M.		
H. W.		
2	00	17.9
	10	18.0
	20	.1
	30	.3
	40	.4
	50	.5
3	00	.55
	10	.6
	20	.6

Second series, 1861.—*Continued.*

June 28 P. M.		
H. W.		
3^h	30^m	$18^{ft}.6$
	40	.5
	50	.4
R.		
L. W.		
8	00	13.6
	10	......
	20	.4
	30	.35
	40	.3
	50	.25
9	00	.25
	10	.25
	20	.3
	30	.35
R.		
June 29 A. M.		
H. W.		
2	00	16.4
	10	.5
	20	.5
	30	.55
	40	.55
	50	.55
3	00	.55
		......
	10	20.8
	20	.8
	30	.7
Uncertain. Guy caught and not discovered till too late.		
R.		
L. W.		
8	30	13.8
	40	.65
	50	.5
9	00	.4
	10	.25
	20	.2
	30	.1
	40	.1
	50	.1
10	00	.1
	10	.1
	20	.3
K.		
P. M.		
H. W.		
2	30	18.5
	40	.8
	50	.9
3^h	00^m	$19^{ft}.0$
	10	.2
	20	.3
	30	.4
	40	.4
	50	.45
4	00	.45
	10	.45
	20	.5
	30	.6
K.		
L. W.		
8	50	15.5
9	00	.4
	10	.35
	20	.3
	30	.2
	40	.2
	50	.2
10	00	.2
	10	3
	20	.5
K.		
June 30 A. M.		
H. W		
3	40	20.2
	50	.4
4	00	.6
	10	.6
	20	.65
	30	.7
	40	.7
	50	.6
5	00	.6
	10	.4
K.		
L. W.		
9	20	14.1
	30	13.95
	40	.85
	50	.75
10	00	.6
	10	.6
	20	.6
	30	.6
	40	.6
	50	.6
11	00	.7
	10	.75
	20	.8
S.		
P. M.		
H. W.		
3	20	18.5
	30	.65
3^h	40^m	$18^{ft}.75$
	50	.85
4	00	.9
	10	19.15
	20	.2
	30	.2
	40	.2
	50	.3
5	00	.4
	10	.4
	20	.35
	30	.35
	40	.3
	50	.25
S.		
L. W.		
9	40	16.1
	50	.0
10	00	15.9
	10	.8
	20	.8
	30	.75
	40	.7
	50	.7
11	00	.7
	10	.7
	20	.8
	30	.85
S.		
July 1 A. M.		
H. W.		
4	10	19.1
	20	.2
	30	.2
	40	.2
	50	.2
5	00	.2
	10	.1
	20	.1
	30	.0
S.		
L. W.		
10	00	14.5
	10	......
	20	.3
	30	.25
	40	.15
	50	.05
11	00	.0
	10	.0
	20	.0
	30	.0
	40	.05
	50	.15
R.		
P. M.		
H. W.		
4^h	30^m	$18^{ft}.9$
	40	19.1
	50	.2
5	00	.3
	10	.5
	20	.6
	30	.65
	40	.7
	50	.75
6	00	.8
	10	.8
	20	.8
	30	.8
	40	.75
	50	.7
7	00	.65
	10	.6
S.		
L. W.		
10	30	16.7
	40	.7
	50	.65
11	00	.55
	10	.45
	20	.35
	30	.3
	40	.2
	50	.2
12	00	.1
	10	.1
	20	.1
	30	.05
	40	.05
	50	05
1	00	.1
	10	.2
R.		
July 2 A. M.		
H. W.		
5	30	18.55
	40	.6
	50	.6
6	00	.6
	10	.6
	20	.5
	30	.45
R.		
L. W.		
11	50	14.2
12	00	.1
	10	.1
	20	.1
	30	.1
	40	.1
	50	.1
1^h	00^m	$14^{ft}.15$
	10	.25
K.		
P. M.		
H. W.		
5	40	19.4
	50	.5
6	00	7
	10	.75
	20	.85
	30	.9
	40	.95
	50	20.0
7	00	.1
	10	.1
	20	.1
	30	.1
	40	.1
	50	.1
8	00	.1
	10	.05
	20	19.9
K.		
L. W.		
11	50	16.65
12	00	.5
	10	.4
	20	.45
	30	.3
	40	.3
	50	.1
1	00	.05
	10	.0
	20	.0
	30	.0
	40	.0
	50	.0
2	00	.0
	10	.1
	20	.25
K.		
July 3 A. M.		
H. W.		
6	10	18.2
	20	.3
	30	.4
	40	.4
	50	.4
7	00	.4
	10	.4
	20	.4
	30	3
	40	.2
K.		

Second series, 1861.—*Continued.*

July 3 P. M.

L. W.

0h	00m	14ft.6
	10	.5
	20	.4
	30	.3
	40	.25
	50	.2
1	00	.15
	10	.1
	20	.1
	30	.1
	40	.1
	50	.15
2	00	.2
	10	.3

S.

H. W.

6	40	19.7
	50	.8
7	00	.9
	10	20.0
	20	.05
	30	.2
	40	.35
	50	.4
8	00	.45
	10	.5
	20	.5
	30	.5
	40	.5
	50	.45
9	00	.4
	10	.3

S.

July 4 A. M.

L. W.

0	30	16.55
	40	.4
	50	.2
1	00	.05
	10	15.9
	20	.75
	30	.6
	40	.5
	50	.4
2	00	.25
	10	.2
	20	.15
	30	.0
	40	.0
	50	.0
3	00	.05
	10	.15

S.

H. W.

7h	00m	17ft.65
	10	.75
	20	.8
	30	.9
	40	18.0
	50	.0
8	00	.0
	10	.0
	20	.0
	30	.0
	40	.0
	50	17.9
9	00	.8

S.

P. M.

L. W.

1	00	14.05
	10	13.9
	20	.8
	30	.65
	40	.6
	50	.5
2	00	.45
	10	.5
	20	.5
	30	.5
	40	.6

R.

H. W.

7	30	19.9
	40	20.1
	50	.25
8	00	.4
	10	.55
	20	.7
	30	.8
	40	.9
	50	.9
9	00	.9
	10	.9
	20	.9
	30	.85
	40	.8

R.

July 5 A. M.

L. W.

2	30	14.75
	40	.65
	50	.6
3	00	.5
	10	.4
	20	.4
	30	.4
	40	.4
	50	.4
4h	00m	14ft.4
	10	.5
	20	.6

R.

H. W.

8	30	18.2
	40	.3
	50	.3
9	00	.3
	10	.3
	20	.3
	30	.25
	40	.2
	50	.0

K.

P. M.

L. W.

2	30	13.3
	40	.25
	50	.2
3	00	.2
	10	.2
	20	.25
	30	.3
	40	.4

S.

H. W.

8	40	15.6
	50	......
9	00	.4
	10	.4
Guy caught		
	20	22.6
	30	.7
	40	.7
	50	.7
10	00	.7
	10	.6
	20	.5

S.

July 6

L. W.

Not observed

A. M.

H. W.

9	00	19.8
	10	20.0
	20	.1
	30	.1
	40	.1
	50	.15
10	00	.15
	10	.1
	20	.05

R.

P. M.

L. W.

3h	00m	14ft.4
	10	.3
	20	.2
	30	.2
	40	.2
	50	.2
4	00	.25
	10	.35
	20	.5

S.

H. W.

9	40	23.3
	50	.35
10	00	.4
	10	.4
	20	.4
	30	.4
	40	.4
	50	.35
11	00	.3
	10	.2

Doubtful, as the pole was covered

S.

July 7 A. M.

L. W.

3	40	14.9
	50	.85
4	00	.7
	10	.55
	20	.45
	30	.35
	40	.35
	50	.35
5	00	.35
	10	.35
	20	.4
	30	.5

R.

H. W.

9	30	19.95
	40	20.15
	50	.3
10	00	.35
	10	.4
	20	.4
	30	.4
	40	.4
	50	.4
11	00	.3
	10	.2

S.

P. M.

L. W.

3h	30m	13ft.95
	40	.8
	50	.7
4	00	.7
	10	.7
	20	.7
	30	.7
	40	.75
	50	.9
5	00	14.05

S.

H. W.

10	00	23.8
	10	.95
	20	24.2
	30	.25
	40	.3
	50	.3
11	00	.3
	10	.2
	20	.15
	30	23.95

S.

July 8 A. M.

L. W.

4	00	14.75
	10	.5
	20	.35
	30	.15
	40	.05
	50	13.9
5	00	.8
	10	.7
	20	.7
	30	.7
	40	.8
	50	.95

S.

H. W.

10	30	20.5
	40	.6
	50	.65
11	00	.7
	10	.7
	20	.6
	30	.5

S.

P. M.

L. W.

3	50	13.7
4	00	.55
	10	.4
	20	.3

Second series, 1861.—*Continued.*

July 8 P. M.		
L. W.		
4^h	30^m	$13^{ft}.15$
	40	.1
	50	.05
5	00	.05
	10	.1
	20	.25
	30	.35
S.		
H. W.		
10	30	23.7
	40	.8
	50	.9
11	00	24.1
	10	.2
	20	.2
	30	.25
	40	.25
	50	.15
12	00	23.95
S.		
July 9 A. M.		
L. W.		
5	00	13.4
	10	.2
	20	.1
	30	.0
	40	12.95
	50	.9
6	00	.9
	10	.95
	20	13.0
R.		
H. W.		
11^h	00^m	$20^{ft}.45$
	10	.5
	20	.6
	30	.6
	40	.6
	50	.6
12	00	.5
K.		
P. M.		
L. W.		
5	00	12.6
	10	.5
	20	.5
	30	.45
	40	.45
	50	.55
6	00	.65
S.		
H. W.		
11	10	23.6
	20	.7
	30	.9
	40	24.0
	50	.0
12	00	.0
	10	.0
	20	.0
	30	23.8
K.		
July 10 A. M.		
L. W.		
5^h	20^m	$13^{ft}.9$
	30	.7
	40	.5
	50	.5
6	00	.5
	10	.65
S.		
H. W.		
11	30	21.0
	40	.1
	50	.2
12	00	.2
	10	.25
	20	.3
	30	.3
	40	.3
	50	.1
1	00	.0
S.		
P. M.		
L. W.		
5	30	13.3
	40	.2
	50	.1
6	00	.1
	10	.1
	20	.1
	30	.2
	40	.3
S.		
H. W.		
11^h	50^m	$24^{ft}.2$
12	00	.3
	10	.35
	20	.5
	30	.5
	40	.45
	50	.4
1	00	.3
S.		
July 11 A. M.		
L. W.		
5	30	13.7
	40	.3
	50	.1
6	00	12.9
	10	.7
	20	.4
	30	.25
	40	.15
	50	.1
7	00	.1
	10	.1
	20	.2
	30	.3
	40	.4
S.		
H. W.		
11	50	20.5
12	00	.7
	10	.9
	20	21.0
	30	.1
	40	.1
12^h	50^m	$21^{ft}.2$
1	00	.2
	10	.15
	20	.1
R.		
P. M.		
L. W.		
6	20	13.0
	30	12.9
	40	.9
	50	.9
7	00	.9
	10	13.0
R.		
July 12 A. M.		
H. W.		
0	30	23.4
	40	.5
	50	.6
1	00	.6
	10	.65
	20	.65
	30	.55
	40	.5
. . . .		
L. W.		
7	00	12.2
	10	1
	20	[illegible]
	30	.0
	40	.0
	50	.05
8	00	.1
. . . .		

The times of the preceding record were taken from a watch set approximately to local mean solar time; the following comparisons between this watch and mean time chronometer No. 2007 were made for the purpose of obtaining the watch correction and rate.

Watch and Chronometer Comparisons for the correction of the times of the Tidal Record.

Date.	Watch.	Chronometer.	Date.	Watch.	Chronometer.
June 6	8^h 56^m 00^s	$= 1^h$ 43^m	June 28	2^h 18^m $41^s.5$ P. M.	$= 7^h$ 04^m
" 7	10 07 45.5 P. M.	2 55	" 30	8 33 35 A. M.	1 32
" 9	10 17 29 "	3 07	July 1	8 39 02 "	1 40
" 11	5 25 36 "	10 15	" 2	8 30 09 "	1 33
" 17	9 08 43.5 A. M.	2 11	" 3	8 34 22 "	1 39
" 19	8 40 29.5 "	1 46	" 4	8 51 51 "	1 58
" 20	8 02 29.2 "	1 09	" 6	9 04 00 "	2 14
" 21	8 48 20 "	1 56	" 7	8 34 24.5 "	1 47
" 25	8 40 23 "	1 35	" 8	8 40 02 "	1 55
	Watch stopped (before the 25th)		" 9	8 45 03 "	2 02
" 26	7 52 21 A. M.	0 43	" 10	8 13 57 "	1 33

The following resulting chronometer corrections (ΔT) of the eight day chronometer No. 2007, on Port Foulke mean time, is extracted from the discussion of the astronomical observations of the expedition (Part I).

June 7, 1861	$\Delta T = -4^h\ 47^m\ 52^s$
July 10, 1861	$-4\ \ 47\ \ 15$
Hence daily rate	$\delta T = \ \ +1^s.1$

With these data we find the corrections ΔT to the watch as follows:—

June 3,	$\Delta T = -0^m.9$	June 21,	$\Delta T = +20^m.1$	July 3,	$\Delta T = +17^m.2$
" 7,	-0.7	" 25,	$+7.1$	" 4,	$+18.7$
" 9,	$+1.7$	" 26,	$+3.2$	" 6,	$+22.7$
" 11,	$+1.6$	" 28,	-2.2	" 7,	$+25.3$
" 17,	$+14.6$	" 30,	$+11.0$	" 8,	$+27.7$
" 19,	$+17.9$	July 1,	$+13.6$	" 9,	$+29.6$
" 20,	$+18.9$	" 2,	$+15.4$	" 10,	$+31.8$

Average daily rate, June 6 to June 21 . . . $+1^m.4$
" " " June 30 to July 10 . . . $+2.1$

The preceding observations, taken at regular intervals near the time of each high and low water, generally suffice to fix the epoch of the highest and lowest level within five minutes. The readings appear quite regular, and are evidently but little affected by agitation of the surface against which the surrounding ice acted as a complete preventive. The mean time during which the same, highest or lowest, readings are recorded has been adopted for the epoch of high or low water, though in some cases a closer process has been attempted by considering the readings preceding and following. If the anterior and posterior slopes of the wave were the same, the average times of any two equal readings of height would give a closer determination; for instance, for low water, June 6 P. M., we have—

Reading 11.9 feet at	. . . . . .			$3^h\ 50^m$
11.95 feet at	$3^h\ 35^m$ and	$4^h\ 10^m$	mean,	3 52
12.0 feet at	3 20	4 25	"	3 52
12.05 feet at	3 10	4 30	"	3 50
	Adopted epoch	. . .		3 51

On the other hand, if the shape of the wave is unsymmetrical, and this is the rule in our case, we find by attempting the above process that the successive times show a regular progression; for instance, the low water, June 7 A. M.—

Reading 12.1 feet at	. . . . . .			$4^h\ 40^m$
12.15 feet at	$4^h\ 30^m$ and	$4^h\ 55^m$	mean,	4 42
12.2 feet at	4 25	5 10	"	4 47
12.25 feet at	4 20	5 20	"	4 50

Here we have to adopt $4^h\ 40^m$ as the epoch of low water.

A graphical process appears to be the best in all cases. Suppose the observations, taken at regular (or irregular) intervals, plotted by rectangular co-ordinates (times and corresponding heights), and a number of parallel level lines ruled across the crest (or trough) of the wave. Halving the length of each of these lines (within the curve) and uniting their middle points by a curve, that curve will generally intersect the wave nearly at right angles, and indicate the highest (or lowest) point in it.

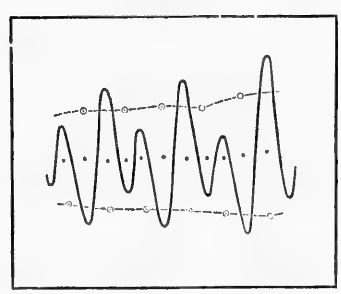
The second part of Table I contains the observed times of high and low water, corrected for error of watch. The adopted watch corrections for June 22d, 23d, and 24th, were +18, +15, and +12^m respectively. For June 29th, the correction was +10^m: and for July 11th and 12th, +33 and +34^m.

Determination of the Mean Level of the Sea.

An inquiry into the reading of the mean level of the sea is important in more than one aspect; first, we may test the value of our observations with respect to the invariability of the zero point of the scale which may change from the following causes: a gradual lengthening of the rope; a gradual shifting of the weight by which it is anchored on the *sloping* bottom by the action of currents, or by ice, and possibly also by a motion in the ice-field itself upon which the tidal apparatus rested, and finally by a change in the position of the weight after the rope had been taken up for repairs and was replaced. Secondly, by marking, at certain epochs, the half-tide level of the sea, which is subject to smaller fluctuations than either the average level of high water or the average level of low water, we may ascertain any relative change in the level of sea and land produced by geological causes. All levelling operations must also be referred to a certain tidal level. Thirdly, since theory points out certain fluctuations in the tidal level of the ocean due to the differential action of the sun and moon, their study and comparison with observation will bring them to a practical test. There are other interesting questions connected with the subject of our inquiry, namely, the effect upon the level of the sea, of a change in the atmospheric pressure as indicated by the readings of the barometer, and also the effect of the wind, with respect to direction, duration, and strength, upon the average height of the sea. The change of the sea level for a given rise or fall of the barometer has only been ascertained for a few places, and the measures fail to show a satisfactory agreement. The effect of the wind is of an entirely local character.

The mean, or more properly the half-tide level, is the one to which all heights should be referred; on the average, therefore, we will have at high tide an equal sectional area of water above, and at low tide an equal sectional area of deficiency. Owing to the daily inequality and the half-monthly inequality, which have to be eliminated, the following process for finding the half-tide level was employed.

Diagram A.



Referring to the annexed diagram (A) to illustrate the numerical method, the mean reading of two successive high waters is taken and placed opposite the reading of the intermediate low water (see series of upper circles in diagram), next the mean of these successive values is placed opposite the intermediate high water. In like manner the mean of two successive low waters is taken and placed opposite the intermediate high water (see series of lower circles in diagram), and their means again are taken; we thus obtain on each horizontal line two values, one high the other low, exactly corresponding in epoch, the mean of which is that of the half-tide level as set out in the last column, thus:—

Date.		Phase.	Readings.	Means.		Means.		Half tide level.
1861.	July 2	L.	16.0					
	" "	H.	18.6			15.05		
	" "	L.	14.1	19.35			15.05	17ft.17
	" "	H.	20 1		19.30	15.05		17.17
	" 3	L.	16.0	19.25			15.05	17.15
	" "	H.	18.4		19.35	15.05		17.20
	" "	L.	14 1	19.45			14.80	17.13
	" "	H.	20.5		19.35	14.55		16.95
	" 4	L.	15.0	19.25			14.37	16.81
	" "	H.	18.0			14.20		
	" "	L.	13.4	etc.				

The following table contains the date, time of high or low water, and corresponding height (corrected if necessary in accordance with preceding remarks), and the half-tide level as made out by the above process; the remaining columns contain the moon's declination at noon of each day, also the moon's parallax for the same epoch, together with the atmospheric pressure (reduced to the temperature 32° Fah., and the prevailing direction and force of the wind during each day.

TABLE I.—Observed times and heights of high and low waters at Port Foulke, latitude 78° 17′.6, longitude $4^h\ 52^m\ 0^s$ west of Greenwich. Also the corresponding half-tide level, the moon's declination, the moon's parallax, the atmospheric pressure (at the temperature of the freezing point of water), and the true direction and force of the wind.

Series I. November and December, 1860.

Date.	High or low tide.	Observed mean time.	Morning or afternoon.	Observed height in feet.	Deduced half-tide level.	Moon's declination.	Moon's paral'x.	Atmos. press.	Direction of wind.	Force of wind.
Nov. 17	H.	$2^h\ 25^m$	A.	16 4	- - - -	—21 .0	56 .4	$29^{in}.7$	calm	
"	L.	9 05	A.	8 2	- - - -					
18	H.	2 50	M.	13 6	11.85					
"	L.	9 30	M.	9 6	11.80	—17 2	55.7	29 9	N. E.	3
"	H.	3 25	A.	15.6	- - - -					
"	L.	10 00	A.	8 6	- - - -					
19	H.	- - - -	M.	- - -	- - - -					
"	L.	- - - -	M.	- - -	- - - -	—12 6	55.0	29 8	N. E.	1
"	H.	4 30	A.	14.7	- - - -					
"	L.	10 15	A.	7 7	- - - -					
20	H.	4 45	M.	12.0	- - - -					
"	L.	- - - -	M.	- - -	- - - -	—7.7	54.6	29 9	N. E.	1
"	H.	- - - -	A.	- - -	- - - -					
"	L.	10 45	A.	8.1	- - - -					

Series I. November and December, 1860.—*Continued.*

Date.	High or low tide.	Observed mean time.	Morning or afternoon.	Observed height in feet.	Deduced half-tide level.	Moon's declination.	Moon's paral'x.	Atmos. press.	Direction of wind.	Force of wind
Nov. 21	H.	- - - -	M.	- - -	- - - -					
"	L.	11^h 50^m	M.	9.7	- - - -	−2°.6	54′.3	$30^{in}.1$	calm	
"	H.	5 20	A.	13.3	- - - -					
22	L.	0 25	M.	7.7	11.03					
"	H.	7 25	M.	13.4	11.11	+2.5	54.1	29.9	N. E.	7
"	L.	0 30	A.	9.7	11.26					
"	H.	7 15	A.	14.0	11.42					
23	L.	1 15	M.	8.2	11.51					
"	H.	8 00?	M.	14.2	11.50	+7.6	54.2	30.0	N. E.	7
"	L.	2 30	A.	9.6	11.44					
"	H.	7 30	A.	14.0	11.55					
24	L.	2 15	M.	7.7	11.61					
"	H.	9 25	M.	15.6	11.51	+12.4	54.3	30.1	N. E.	2
"	L.	3 30	A.	8.7	- - - -					
"	H.	8 10	A.	14.1	- - - -					
25	L.	- - - -	M.	- - -	- - - -					
"	H.	- - - -	M.	- - -	- - - -	+16.9	54.7	30.7	calm	
"	L.	- - - -	A.	- - -	- - - -					
"	H.	- - - -	A.	- - -	- - - -					
26	L.	3 25	M.	6.6	- - - -					
"	H.	10 00	M.	15.6	- - - -	+20.7	55.1	30.5	N. E.	3
"	L.	4 15	A.	7.6	11.13					
"	H.	10 00	A.	14.8	11.42					
27	L.	4 00	M.	6.5	11.73					
"	H.	10 30	M.	18.0	11.77	+23.6	55.5	30.1	calm	
"	L.	4 40	A.	7.7	11.68					
"	H.	10 45	A.	15.0	11.62					
28	L.	4 35	M.	5.6	11.58					
"	H.	11 00	M.	18.4	11.46	+25.4	56.0	30.2	S. W.	4
"	L.	5 30	A.	7.0	11.47					
"	H.	10 55	A.	14.7	11.75					
29	L.	4 45	M.	6.0	12.26					
"	H.	11 40	M.	20.2	12.95	+25.9	56.5	30.2	N. E.	2
"	L.	6 45	A.	9.3	13.71					
30	H.	0 30	M.	17.9	14.15					
"	L.	5 30	M.	8.9	14.26	+25.0	57.0	29.9	calm	
"	H.	0 15	A.	20.8	14.18					
"	L.	6 30	A.	9.6	14.10					
Dec. 1	H.	1 00	M.	17.0	14.03					
"	L.	6 30	M.	9.1	13.88	+22.6	57.5	30.3	S. W.	[illegible]
"	H.	0 45	A.	20.1	13.76					
"	L.	7 40	A.	9.1	13.68					
2	H.	1 00	M.	16.5	13.62					
"	L.	6 45	M.	9.0	13.52	+19.0	57.9	30.4	calm	
"	H.	1 30	A.	19.7	13.46					
"	L.	8 00	A.	8.8	13.47					
3	H.	2 10	M.	16.2	13.38					
"	L.	7 30	M.	9.4	13.27	+14.4	58.3	30.0	N. E.	4
"	H.	1 30	A.	18.6	13.21					
"	L.	8 10	A.	9.0	13.15					
4	H.	3 00?	M.	15.5 ?	13.35					
"	L.	8 15	M.	9.6	13.66	+8.9	58.7	29.7	calm	
"	H.	3 00	A.	20.0	13.92					
"	L.	10 10	A.	10.1	14.33					
5	H.	4 30	M.	16.5	14.35					
"	L.	9 45	M.	11.9	14.06	+3.0	59.1	29.7	N. E.	3
"	H.	4 35	A.	17.8 ?	14.16					
"	L.	10 45	A.	10.0	14.32					

Series I. November and December, 1860.—*Continued*

Date.	High or low tide.	Observed Mean time.	Morning or afternoon.	Observed height in feet.	Deduced half-tide level.	Moon's declina-tion.	Moon's paral'x.	Atmos. press.	Direction of wind.	Force of wind.
Dec. 6	H.	4^{h} 45^{m}	M.	17.4	14.33					
"	L.	10 55	M	12.3	14.17	—3°.2	59'.3	29^{in}.8	N. E	7
"	H.	6 35	[illegible]	17.5	13.96					
"	L.	11 15	[illegible]	9.0	13.91					
7	H.	6 55	M.	16.7	13.93					
"	L.	0 15	A.	12.6	13.98	—9.3	59.5	29.8	N. E.	7
"	H.	6 40	A.	17.3	14.11					
8	L.	0 30	M	9.2	14.17					
"	H.	7 30	M.	18.0	14.08	—14.9	59.6	29.8	N. E	8
"	L.	1 45	A.	11.8	13.96					
"	H.	7 30	A.	17.3	13.95					
9	L.	3 00	M	8.3	13.72					
"	H.	8 40	M.	18.8	13.30	—19.7	59.6	29.7	N. E.	8
"	L.	2 30	A.	9.2	13.30					
"	H.	8 45	A.	16.5	13.55					
10	L.	2 30	M.	9.1	13.92					
"	H.	9 15	M.	20.0	....	—23.3	59.3	29.6	N. E	8
"	L.	3 15	A.	11.0	....					
"	H.	....	A.	...	....					
11	L.	....	M.	...	....					
"	H.	....	M.	...	....	—25.4	59.0	29.8	N. E.	4
"	L.	4 30	A.	12.1	....					
"	H.	10 30	A.	19.7	....					
12	L.	4 30	M.	11.4	16.52					
"	H.	11 00	M.	23.0	16.50	—25.9	58.4	30.2	N. E.	4
"	L.	5 15	A.	11.9	16.45					
"	H.	11 15	A.	19.7	16.40					
13	L.	5 00	M.	11.0	16.39					
"	H.	11 15	M.	23.0	16.37	—24.7	57.8	30.4	N. E	6
"	L.	5 30	A.	11.8	16.46					
"	H.	12 00	A.	19.7	16.65					
14	L.	6 00	M.	11.7	16.73					
"	H.	0 15	A.	23.8	16.72	—22.2	57.0	29.9	calm	
"	L.	6 45	A.	11.7	16.73					
15	H.	0 45	M.	19.7	16.65					
"	L.	7 00	M.	11.8	16.58	—18.6	56.3	29.7	N. E.	4
"	H.	1 00	A.	23.0	16.56					
"	L.	7 15	A.	12.0	16.56					
16	H.	1 45	M.	19.2	16.60					
"	L.	7 15	M.	12.3	16.67	—14.2	55.6	29.4	N. E.	5
"	H.	2 00	A.	22.8	16.83					
"	L.	8 00	A.	12.8	....					
17	H.	1 45	M.	19.7	....					
"	L.	....	M.	...	....	—9.3	55.1	29.6	calm	
"	H.	2 30	A.	22.1	....					
"	L.	9 00	A.	12.7	....					
18	H.	3 00	M.	18.6	16.50					
"	L.	9 00	M.	13.3	16.35	—4.2	54.6	30.0	calm	
"	H.	3 00?	A.	20.7	16.35					
"	L.	9 30	A.	12.9	16.41					
19	H.	3 45	M.	18.4	16.45					
"	L.	9 30?	M.	14.0?	16.42	+0.9	54.3	30.1	variable	3
"	H.	3 30?	A.	20.2?	16.42					
"	L.	10 15	A.	13.3	16.50					
20	H.	4 45	M.	18.0	16.45					
"	L.	10 30	M.	15.0	16.21	+6.1	54.2	30.3	S. W	6
"	H.	5 15	A.	18.8	....					
"	L.	11 00	A.	12.8	....					

Series I. November and December, 1860.—*Continued.*

Date.	High or low tide.	Observed mean time.	Morning or afternoon.	Observed height in feet.	Deduced half-tide level.	Moon's declination.	Moon's paral'x.	Atmos. press.	Direction of wind.	Force of wind
Dec. 21	H.	- - - - -	M.	- - -	- - - -					
"	L.	11^h 00^m	M.	15.1	- - - -	+11°.0	54'.3	$30^{in}.6$	calm	
"	H.	5 00	A.	18.0	- - - -					
"	L.	11 45	A.	13.2	16.14					
22	H.	6 45	M.	18.2	16.06					
"	L.	1 00	A.	15.2 ·	15.98	+15.5	54.5	30.5	calm	
"	H.	7 00	A.	17.3	16.07					
23	L.	0 45	M	13.2	16.15					
"	H.	8 00	M.	19.0	16.23	+19.5	54.9	30.3	calm	
"	L.	1 30	A.	15.0	- - - -					
"	H.	7 30	A.	18.2	- - - -					
Series II. June and July, 1861.										
June 6	H.	10 09	M.	17.85	- - - -					
"	L.	3 50	A.	11.95	- - - -	+22.8	54.6	29.5	N. E.	3
"	H.	10 29	A.	20.8	15.70					
7	L.	4 39	M.	12.1	15.68					
"	H.	- - - - -	M.	18.1?	15.73	+24.5	54.9	29.6	N. E.	3
"	L.	4 29	A.	11.5	15.82					
"	H.	11 05	A.	21.65	15.90					
8	L.	5 35	M.	12.05	15.97					
"	H.	11 10	M.	18.72	16.04	+25.2	55.3	29.6	N. E.	1
"	L.	4 46	A.	11.5	16.11					
"	H.	11 36	A.	22.2	16.11					
9	L.	6 02	M.	12.0	16 14					
"	H.	11 37	M.	18.8	16.18	+24.5	55.8	29.5	calm	
"	L.	5 32	A.	11.65	16.21					
10	H.	0 12	M.	22.4	16.25					
"	L.	6 37	M.	12.0	16.32	+22.6	56.3	29.5	N. E.	2
"	H.	0 27	A.	19.1	16.40					
"	L.	6 12	A.	11.9	16.43					
11	H.	0 42	M.	22.8	16.40					
"	L.	7 13	M.	11.9	16.37	+19.5	56.8	29.7	calm	
"	H.	0 53	A.	18.9	16.30					
"	L.	6 44	A.	11.9	16.18					
12	H.	1 24	M.	22.2	16.11					
"	L.	8 00	M.	11.6	16.11	+15.3	57.3	29.8	S. W.	2
"	H.	1 45	A.	18.6	16.08					
"	L.	7 56	A.	12.2	16.06					
13	H.	2 01	M.	21.7	16.12					
"	L.	8 12	M.	11.9	16.25	+10.3	57.9	29.8	S. W.	1
"	H.	2 32	A.	18.75	16.32					
"	L.	8 13	A.	13.15	16.29					
14	H.	2 48	M.	21.35	16.27					
"	L.	9 04	M.	11.9	16.25	+4.7	58.4	29.9	S. W.	1
"	H.	3 29	A.	18.65	16.13					
"	L.	9 25	A.	13.05	16.02					
15	H.	3 40	M.	20.55	16.05					
"	L.	10 16	M.	11.8	16.21	—1.1	58.9	29.9	S. W.	2
"	H.	4 26	A.	19.0	16.35					
"	L.	10 17	A.	14.0	- - - -					
16	H.	4 07	M.	20.7	- - - -					
"	L.	- - - - -	M.	- - - -	- - - -	—7.0	59.3	29.7	S. W.	7
"	H.	- - - - -	A.	- - - -	- - - -					
"	L.	- - - - -	A.	- - - -	- - - -					

Series II. June and July, 1861.—*Continued*

Date.	High or low tide.	Observed mean time.	Morning or afternoon.	Observed height in feet.	Deduced half-tide level.	Moon's declination.	Moon's paral'x.	Atmos. press.	Direction of wind.	Force of wind.
June 17	H.	- - - - -	M.	- - - -	- - - -					
"	L.	- - - - -	A.	- - - -	- - - -	—12°.6	59'.7	30in.0	S. W.	7
"	H.	6h 35m	A.	20.75	- - - -					
18	L.	0 25	M.	14.1	- - - -					
"	H.	7 01	M.	19.0	16.52	—17.6	59.9	29.9	S. W.	5
"	L.	0 46	A.	12.3	16.48					
"	H.	7 57	A.	20.65	16.47					
19	L.	1 52	M.	13.9	16.48					
"	H.	7 52	M.	19.1	16.61	—21.6	60.0	29.7	S. W.	5
"	L.	1 38	A.	12.3	- - - -					
"	H.	8 53	A.	21.65	- - - -					
20	L.	- - - - -	M.	- - - -	- - - -					
"	H.	8 54	M.	19.05	- - - -	—24.2	60.0	29.8	S. W.	2
"	L.	2 34	A.	12.45	- - - -					
"	H.	9 44	A.	21.7	16.34					
21	L.	3 20	M.	12.5	16.00					
"	H.	9 50	M.	18.4	15.77	—25.2	59.7	29.9	calm	
"	L.	4 15	A.	10.3	15.68					
"	H.	10 50	A.	22.1	15.58					
22	L.	5 40	M.	11.3	15.65					
"	H.	- - - - -	M.	18.8?	15.75	—24.4	59.2	29.9	S. W.	1
"	L.	5 18	A.	10.5	15.75					
"	H.	11 37	A.	22.7	15.70					
23	L.	6 06	M.	10.7	15.70					
"	H.	11 50	M.	19.0	15.70	—22.2	58.5	29.8	variable	1
"	L.	5 34	A.	10.35	15.69					
24	H.	0 13	M.	22.75	15.70					
"	L.	6 52	M.	10.6	15.78	—18.7	57.7	29.6	variable	1
"	H.	0 31	A.	19.2	15.85					
"	L.	6 10	A.	10.8	15.89					
25	H.	0 48	M.	22.9	15.90					
"	L.	7 17	M.	10.7	15.97	—14.3	57.0	29.5	S. W.	7
"	H.	1 12	A.	19.25	16.00					
"	L.	7 01	A.	11.3	16.00					
26	H.	1 30	M.	22.6	16.01					
"	L.	7 49	M.	11.05	16.05	—9.4	56.2	29.6	S. W.	7
"	H.	2 03	A.	19.0	16.03					
"	L.	7 43	A.	11.8	16.09					
27	H.	2 17	M.	22.0	16.03					
"	L.	8 46	M.	11.4	16.12	—4.2	55.5	29.5	S. W.	5
"	H.	2 40	A.	18.9	16.11					
"	L.	8 10	A.	12.6	16.00					
28	H.	2 24	M.	21.1	16.06					
"	L.	9 03	M.	11.8	16.11	+0.9	54.9	29.4	calm	
"	H.	3 18	A.	18.6	16.15					
"	L.	8 58	A.	13.25	16.27					
29	H.	3 19?	M.	20.8	16.54					
"	L.	9 59	M.	13.1	16.89	+6.1	54.5	29.4	calm	
"	H.	4 10	A.	19.45	17.12					
"	L.	9 55	A.	15.2	17.17					
30	H.	4 46	M.	20.7	17.23					
"	L.	10 36	M.	13.6	17.28	+10.8	54.3	29.4	calm	
"	H.	5 16	A.	19.4	17.16					
"	L.	11 07	A.	15.7	17.02					
July 1	H.	4 52	M.	19.2	17.12					
"	L.	11 28	M.	14.0	17.21	+15.2	54.2	29.3	S. W.	1
"	H.	6 29	A.	19.8	17.18					

Series II. June and July, 1861.—*Continued.*

Date.	High or low tide.	Observed mean time.	Morning or afternoon.	Observed height in feet.	Deduced half-tide level.	Moon's declination.	Moon's paral'x.	Atmos. press.	Direction of wind.	Force of wind.
July 2	L.	0^h 54^m	M.	16.05	17.12					
"	H.	6 10	M.	18.6	17.17	+19°.0	54'.3	$29^{in}.4$	calm	
"	L.	0 40	A.	14.1	17.20					
"	H.	7 46	A.	20.1	17.17					
3	L.	1 51	M.	16.0	17.15					
"	H.	7 12	M.	18.4	17.20	+22.0	54.5	29.4	calm	
"	L.	1 42	A.	14.1	17.12					
"	H.	8 42	A.	20.5	16.95					
4	L.	2 58	M.	15.0	16.82					
"	H.	8 28	M.	18.0	16.78	+24.2	54.9	29.7	S. W.	1
"	L.	2 24	A.	13.45	16.76					
"	H.	9 19	A.	20.9	16.72					
5	L.	3 55	M.	14.4	16.73					
"	H.	9 20	M.	18.3	16.92	+25.1	55.4	29.6	variable	2
"	L.	3 21	A.	13.2	....					
"	H.	10 06	A.	22.7	....					
6	L.	......	M.	....	....					
"	H.	10 17	M.	20.15	....	+24.9	55.9	29.4	N. E.	1
"	L.	3 58	A.	14.2	....					
"	H.	10 43?	A.	23.4 ?	18.05					
7	L.	5 14	M.	14.35	18.02					
"	H.	10 54	M.	20.4	18.07	+23.3	56.5	29.6	calm	
"	L.	4 35	A.	13.7	18.10					
"	H.	11 16	A.	24.3	18.06					
8	L.	5 47	M.	13.7	18.01					
"	H.	11 33	M.	20.7	17.93	+20.4	57.0	29.7	variable	1
"	L.	5 23	A.	13.05	17.83					
9	H.	0 04	M.	24.25	17.71					
"	L.	6 24	M.	12.9	17.62	+16.4	57.6	29.9	N. E.	1
"	H.	0 05	A.	20.6	17.51					
"	L.	6 05	A.	12.45	17.56					
10	H.	0 31	M.	24.0	17.72					
"	L.	6 21	M.	13.5	17.89	+11 6	58.1	29 6	variable	3
"	H.	1 02	A.	21.3	18.03					
"	L.	6 37	A.	13.1	17.92					
11	H.	0 58	M.	24.5	17.74					
"	L.	7 31	M.	12.1	17.70	+6.0	58.5	29.9	S. W.	1
"	H.	1 28	A.	21.2	17.56					
"	L.	7 19	A.	12.9	17.44					
12	H.	1 49	M.	23.65	....					
"	L.	8 04	M.	12.0	....	+0.2	58.8	29.7	N. E.	1

If we now unite the four (generally) values for half-tide level of each day into a mean, we find the following daily results:—

Series I. 1860.			Series II. 1861.		
	Half-tide.	☾'s declination.		Half-tide.	☾'s declination.
November 17	....	−21°.0	June 6	15$^{\text{ft}}$.70	+22°.8
" 18	11$^{\text{ft}}$.82	−17.2	" 7	15.78	+24.5
" 19	....	−12.6	" 8	16.06	+25.2
" 20	....	− 7.7	" 9	16.18	+24.5
" 21	11.21	− 2.6	" 10	16.35	+22.6
" 22	11.50	+ 2.5	" 11	16.31	+19.5
" 23	11.56	+ 7.6	" 12	16.09	+15.3
" 24	....	+12.4	" 13	16.24	+10.3
" 25	....	+16.9	" 14	16.17	+ 4.7
" 26	11.28	+20.7	" 15	16.20	− 1.1
" 27	11.70	+23.6	" 16	....	− 7.0
" 28	11.56	+25.4	" 17	....	−12.6
" 29	12.97	+25.9	" 18	16.49	−17.6
" 30	14.20	+25.0	" 19	16.54	−21.6
December 1	13.84	+22.6	" 20	16.34	−24.2
" 2	13.52	+19.0	" 21	15.76	−25.2
" 3	13.25	+14.4	" 22	15.71	−24.4
" 4	13.81	+ 8.9	" 23	15.70	−22.2
" 5	14.22	+ 3.0	" 24	15.80	−18.7
" 6	14.09	− 3.2	" 25	15.97	−14.3
" 7	14.00	− 9.3	" 26	16.02	− 9.4
" 8	14.04	−14.9	" 27	16.06	− 4.2
" 9	13.47	−19.7	" 28	16.15	+ 0.9
" 10	13.92	−23.3	" 29	16.93	+ 6.1
" 11	....	−25.4	" 30	17.17	+10.8
" 12	16.47	−25.9	July 1	17.17	+15.2
" 13	16.47	−24.7	" 2	17.17	+19.0
" 14	16.73	−22.2	" 3	17.11	+22.0
" 15	16.59	−18.6	" 4	16.77	+24.2
" 16	16.70	−14.2	" 5	16.82	+25.1
" 17	....	− 9.3	" 6	18.05	+24.9
" 18	16.40	− 4.2	" 7	18.06	+23.3
" 19	16.45	+ 0.9	" 8	17.92	+20.4
" 20	16.33	+ 6.1	" 9	17.60	+16.4
" 21	16.14	+11.0	" 10	17.89	+11.6
" 22	16.04	+15.5	" 11	17.61	+ 6.0
" 23	16.19	+19.5	" 12	....	+ 0.2

An examination of the figures makes it evident that the zero shifted between November 28th and 30th, from some unexplained cause, by about 2.4 feet, and again on the 4th and 10th of December by 0.7 and 2.5 feet respectively, on which dates the tide rope had been taken up and replaced. These displacements are all in the same direction, indicating deeper water. In the second series there are breaks between June 20th and 21st, between June 28th and 29th, and on July 6th, of —0.7, +0.9, and +1.2 foot respectively, all in consequence of a derangement of the apparatus as stated in the record. The breaking down of the apparatus on June 17th does not appear to have affected the mean level reading.

Variation in the Mean Level of the Sea.—In accordance with the equilibrium and wave theories (533) of "Tides and Waves," by G. B. Airy, Astronomer Royal,

Encyclopædia Metropolitana, the variation of the mean level of the sea depends upon the changes of the moon's and sun's declinations, but as the latter goes through its changes in half a year, and as the zero levels of our two series are disconnected, we can only examine the lunar effect, which can be expressed by $C \sin^2\delta$, where the constant C amounts to a few inches to be determined by observation. The constant C is greater in low and high latitudes, and very small in middle latitudes. The oscillation will go through its changes in half a lunation ($14\frac{3}{4}$ days), and we may expect high level at the greatest declination, *independent* of the sign, and low level when the moon is in the equator.

The breaks in our mean level readings, as examined above, sufficiently demonstrate the insufficiency of the accuracy of our observations for so delicate an inquiry as the variation in the mean level; in some portions of the series the dependence of this level upon the declination appears systematic, but is hidden in other portions by irregularities. In Series I the mean of three readings of the level for $\delta = 0$ (after applying the corrections indicated) is 16.67, and for $\delta = \pm 26°$ from two readings is 16.88 feet, range $2\frac{1}{2}$ inches; in series II the mean of three readings (after applying the corrections indicated) is the same (17.80 feet) for $\delta = 0$ and $\delta = \pm 25°$, on the average therefore we would only have between one and two inches of oscillation.

But few investigations into the variations of the mean level have been made, and more complete comparisons of observation and theory, on this point, are very desirable.

Effect of Changes in the Atmospheric Pressure upon the Tides.—Considering the short series of observations any result for the dependence of the changes of the height of the barometric column upon those of the sea level can only be a first approximation, the result deduced from the observations is nevertheless entitled to some confidence. The treatment adopted was the following:—

The mean levels, each day, and for each series independently, were grouped in two columns for days with barometer *below*, and for days with barometer *above* its average value (30.01 inches for Series I, and 29.65 inches for Series II). The corresponding difference from the average value was also set down, and then the mean of the whole series taken, thus:—

For Series I, average level $16^{ft}.7$, average depression of barometer $0^{in}.22$
" " 16.6, " elevation " 0.24
Or —1 inch of change of level for $0^{in}.46$ of change of barometer.

For Series II, average level $18^{ft}.0$, average depression of barometer $0^{in}.15$
" " 17.8, " elevation " 0.17
Or —2 inches of change of level for $0^{in}.32$ of change of barometer.

From the two series combined we obtain therefore a change of —3 inches for a change of $\frac{3}{4}$ inch (nearly) in the barometric column; in other words, a rise of one inch of the barometric column will be accompanied by a corresponding fall in the level of the water of four inches nearly.

This result is also affected by any *uncompensated* part, by reason of the short series of observations, of the effect of the variation in the mean level, and also of the effect of the wind.

Investigations made by different methods for a few places, give very discordant results; for London, Mr. Lubbock found 7 inches, for Bristol, Mr. Bunt found 13 inches, and Sir J. C. Ross, in a late number of the Philosophical Transactions (for 1854, Part II), deduced from observations at Port Leopold, in latitude 74° N., longitude 91° W., nearly the same value as that given for Bristol, stating that the effect is nearly in the *inverse* ratio of the specific gravity of the two bodies (mercury and water).

The subject is open to further investigations, and considering that an increase or decrease of atmospheric pressure in any one place must necessarily be accompanied by currents restoring the disturbed equilibrium, the phenomenon would seem more complex than might at first be supposed.

Effect of the Wind upon the Mean Level of the Sea.—As this effect is of an entirely local character, the result will be of importance only in so far as it affects the local phenomena of the tides; in refined tidal discussions the effect of the wind must be eliminated, and for *predicted* tides the possible influence it may exert, specially when for spring or neap tides, may become a matter of grave interest. Looking over the columns of the wind record in Table I it appears that the prevailing wind is either N. E. or S. W.; there occur some calms and a few entries of variable winds.

Tabulating, for each series of observations separately, the mean level reading, referred to the same zero by application of the corrections given, for days of N. E. wind, for days of S. W. wind, and for days of calms (including variables), the following results were obtained:—

Series I. Mean level with N. E. wind 16.6 feet (15 observations), with calms 16.6 feet (10 observations), with S. W. wind 16.8 feet (3 observations).

Series II. Mean level with N. E. wind 17.5 feet (6 observations), with calms 18.0 feet (15 observations), with S. W. wind 17.9 feet (13 observations).

With consideration of the number of days of observation in each case, the effect of the wind appears very small, with N. E. wind the level is depressed a small fraction of a foot, and with a S. W. wind elevated by the same amount. A northeast wind blowing off the land, and a southwest wind blowing on it, would produce the effect as stated. Two causes operate *against* a considerable change in the level, first the open strait giving free passage to accumulated waters, to the northward or southward, and secondly, the protection of ice-fields, preventing the wind from acting on the surface of the sea.

We have seen that the effect upon the height of the tides produced either by the regular oscillation of the half-tide level, or by the irregular changes in the atmospheric pressure and the action of the winds, is sufficiently small at Port Foulke to be safely left out of consideration in our subsequent investigations; the corrections alone will be needed which refer all observations to the *same zero* of the height scale; they are for series I: Between November 17th and 28th, +5.6 feet; between November 30th and December 3d, +3.2 feet; between December 5th and 10th, +2.5 feet. For series II: Between June 6th and 20th, +1.4 foot; between June

21st and 28th, +2.1 feet; and between June 29th and July 5th, +1.2 foot. The mean level reading for Series I is 16.7, and for Series II 17.9 feet; these levels, however, are disconnected.

General Character of the Port Foulke Tides.—We find by the subsequent analysis of the two series of observations, with respect to the half-monthly and the diurnal inequalities, that their general character is very much the same as that exhibited by the Van Rensselaer Harbor tides, a result which was to be expected since the two localities are but 55 statute miles apart (following the sinuosities of the coast line), with no apparent special configuration of the shore which might exert an influence on the tidal feature. The establishment at Port Foulke is nearly half an hour less than that of Van Rensselaer Harbor, consistent with the northerly (and easterly) propagation of the tidal wave. The average range of the tide is almost exactly the same at the two places. There is at Port Foulke a considerable diurnal inequality which *almost* reaches, at certain times, that limit beyond which a single-day tide is produced; the diurnal inequality in the height of high water is *greater* than in the height of low water; these features of the diurnal inequality are also common to the two localities.

We shall now proceed with the special investigation of the inequalities commencing with that which runs through its period in half a month. For this purpose Table II has been prepared. The second column contains the time of the moon's transit over the Port Foulke meridian, interpolated from the American Nautical Almanac; the lower transit is distinguished by being placed between brackets. The epochs of high and low tides are taken from Table I. Mean time has been adopted throughout, as no special advantage can be derived from the use of apparent time for so short a series of observations. The transit of the moon given is that one which *immediately precedes* the time of high or low water; the lunitidal intervals are given accordingly; those within brackets depend upon the lower transit of the moon. The fact that various *anterior* positions of the moon are required for the explanation of various tidal inequalities justifies us in using, in a first investigation, the *preceding* transit; the subject will again be referred to in connection with the moon's parallactic and declination effects. The reason why no *one* anterior lunar epoch will answer, even for ports on the same coast and at no very great distance apart, must be sought for, I think, in the compound character of the wave, composed of *propagated* and *direct* effects, the velocity of the various parts being differently affected by the variations in the depth of the sea over which these waves pass.

TABLE II.—Time of the moon's upper and lower transit over the meridian of Port Foulke; time, height, and establishment of high and low water.

Series I. November and December, 1860.

Date.	Moon's upper and lower transit.	Time of high water.	Time of low water.	Lunitidal interval of high water.	Lunitidal interval of low water.	Height of high water.	Height of low water.
Nov. 17	(3^h 44^m)	- - - -	- - - -	- - - - - - -	- - - - - - -	- - - -	- - - -
"	4 10	2^h 25^m	9^h 05^m	(10^h 41^m)	(17^h 21^m)	22ft 0	13.8
18	(4 33)	2 50	9 30	10 40	17 20	19.2	13.2
"	4 57	3 25	10 00	(10 52)	(17 27)	21.2	11.2
19	(5 19)	- - - -	- - - - -	- - - - - - -	- - - - - -	- - -	- - - -
"	5 41	4 30	10 15	(11 11)	(16 56)	20.3	13.3
20	(6 02)	4 45	- - - - -	11 04	- - - - - -	17.6	- - - -
"	6 23	- - - -	10 45	- - - - - - -	(16 43)	- - -	13.7
21	(6 43)	- - - -	11 50	- - - - - - -	17 27	- - -	13.3
"	7 03	5 20		(10 37)		18.9	
22	(7 23)	7 25	0 25	12 22	(17 42)	19.0	13.3
"	7 43	7 15	0 30	(11 52)	17 27	19.6	13.3
23	(8 03)	8 00?	1 15	12 17?	(17 52)	19.8	13.8
"	8 23	7 30	2 30	(11 27)	18 47	19.6	13.2
24	(8 44)	9 25	2 15	13 02	(18 12)	21.2	13.3
"	9 06	8 10	3 30	(11 26)	19 07	19.7	11.3
25	(9 28)	- - - - -	- - - -	- - - - - - -	- - - - -	- - -	- - - -
"	9 50	- - - - -	- - - -	- - - - - - -	- - - - -	- - -	- - - -
26	(10 14)	10 00	3 25	12 10	(17 57)	21.2	12.2
"	10 38	10 00	4 15	(11 46)	18 25	20.4	13.2
27	(11 03)	10 30	4 00	11 52	(17 46)	23.6	12.1
"	11 29	10 45	4 10	(11 42)	18 02	20.6	13.3
28	(11 56)	11 00	4 55	11 21	(17 32)	24.0	11.2
"		10 55	[illegible] 30	(10 53)	18 01	20.3	12.6
29	0 24	11 40	4 45	11 16	(16 49)	24.6	11.6
"	(0 51)		6 45		18 21		12.5
30	1 19	0 30	5 30	(11 39)	(16 39)	21.1	12.1
"	(1 47)	0 15	6 30	10 56	17 11	21.0	12.8
Dec. 1	2 15	1 00	6 30	(11 13)	(16 43)	20.2	12.5
"	(2 42)	0 45	7 10	10 50	17 25	23.3	12.3
2	3 10	1 00	6 45	(10 18)	(16 03)	19.7	12.2
"	(3 36)	1 30	8 00	10 20	16 50	22.9	12.0
3	4 02	2 10	7 30	(10 34)	(15 54)	19.4	12.6
"	(4 27)	1 30	8 10	9 28	16 08	21.8	12.2
4	4 52	3 00?	8 15	(10 33?)	(15 18)	18.7?	12.5
"	(5 16)	3 00	10 10	10 08	17 18	22.5	12.6
5	5 41	4 30	9 45	(11 14)	(16 29)	19.0	11.4
"	(6 05)	4 35	10 45	10 54	17 04	20.3?	12.5
6	6 30	4 45	10 55	(10 40)	(16 50)	19.9	11.8
"	(6 54)	6 35	11 15	12 05	16 45	20.0	11.5
7	7 19	6 55		(12 01)		19.2	
"	(7 45)	6 40	0 15	11 21	(17 21)	19.8	13.4
8	8 11	7 30	0 30	(11 45)	17 11	20.5	11.7
"	(8 37)	7 30	1 45	11 19	(18 00)	19.8	11.3
9	9 04	8 40	3 00	(12 03)	18 49	21.3	10.8
"	(9 33)	8 45	2 30	11 41	(17 53)	19.0	11.7
10	10 02	9 15	2 30	(11 42)	17 26	22.5	11.6
"	(10 32)	- - - -	3 15	- - - - - - -	(17 42)	- - -	13.5
11	11 02	- - - -	- - - -	- - - - - - -	- - - - -	- - -	- - - -
"	(11 32)	10 30	4 30	11 28	(17 58)	19.7	12.1
12		11 00	4 30	(11 28)	17 28	23.0	11.4
"	0 03	11 15	5 15	11 12	(17 43)	19.7	11.5

Series I. November and December, 1860.—*Continued.*

Date.	Moon's upper and lower transit.	Time of high water.	Time of low water.	Lunitidal interval of high water.	Lunitidal interval of low water.	Height of high water.	Height of low water.
Dec. 13	$(0^h\ 33^m)$	$11^h\ 15^m$	$5^h\ 00^m$	$(10^h\ 42^m)$	$16^h\ 57^m$	$23^{ft}.0$	$11^{ft}.0$
"	1 02		5 30		(16 57)		11.8
14	(1 30)	0 00	6 00	10 58	16 58	19.7	11.7
"	1 57	0 15	6 45	(10 45)	(17 15)	23.8	11.7
15	(2 22)	0 45	7 00	10 48	17 03	19.7	11.8
"	2 48	1 00	7 15	(10 38)	(16 53)	23.0	12.0
16	(3 11)	1 45	7 15	10 57	16 27	19.2	12.3
"	3 35	2 00	8 00	(10 49)	(16 49)	22.8	12.8
17	(3 56)	1 45	- - - - -	10 10	- - - - -	19.7	- - -
"	4 18	2 30	9 00	(1[illegible] 31)	(17 04)	22.1	12.7
18	(4 38)	3 00	9 00	10 42	16 42	18.6	13.3
"	4 59	3 00?	9 36	(10 22)?	(16 52)	20.7	12.9
19	(5 15)	3 45	9 30?	10 46	16 31?	18.4	14.0?
"	5 39	3 30?	10 15	(10 15?)	(17 00)	20.2?	13.3
20	(5 59)	4 45	10 30	11 0[illegible]	16 51	18.0	15.0
"	6 19	5 15	11 00	(11 16)	(17 01)	18.8	12.8
21	(6 40)	- - - - - -	11 00	- - - - -	16 41	- - - -	15.1
"	7 00	5 00	11 45	(10 2[illegible]	(17 05)	18.0	13.2
22	(7 22)	6 45		11 [illegible]		18.2	
"	7 43	7 00	1 00	[illegible]	18 00	17.3	15.2
23	(8 06)	8 00	0 45	12 17	(17 23)	19.0	13.2
"	[illegible]	7 30	1 30	(11 24)	17 47	18.2	15.0

Series II. June and July, 1861.

Date.	Moon's upper and lower transit.	Time of high water.	Time of low water.	Lunitidal interval of high water.	Lunitidal interval of low water.	Height of high water.	Height of low water.
June 5							
"	(9 58)						
6	10 22	10 09	- - - - -	(12 11)	- - - - -	19.3	- - -
"	(10 47)	10 29	3 50	12 07	(17 52)	22.2	13.3
7	11 12	- - - - -	4 39	- - - - -	18 17	19.5?	13.5
"	(11 38)	11 05	4 29	11 53	(17 42)	23.1	12.9
8		11 10	5 35	(11 32)	18 23	20.1	13.4
"	0 05	11 36	4 46	11 31	(17 08)	23.6	12.9
9	(0 31)	11 37	6 02	(11 06)	17 57	20.2	13.4
"	0 58		5 32		(17 01)		13.0
10	(1 24)	0 12	6 37	11 14	17 39	23.8	13.4
"	1 50	0 27	6 12	(11 03)	(16 48)	20.5	13.3
11	(2 16)	0 42	7 13	10 52	17 23	24.2	13.3
"	2 42	0 53	6 44	(10 37)	(16 28)	20.3	13.3
12	(3 07)	1 24	8 00	10 42	17 18	23.6	13.0
"	3 32	1 45	7 56	(10 38)	(16 49)	20.0	13.6
13	(3 56)	2 01	8 12	10 29	16 40	23.1	13.3
"	4 21	2 32	8 13	(10 36)	(16 17)	20.2	14.5
14	(4 45)	2 48	9 04	10 27	16 43	22.8	13.3
"	5 09	3 29	9 25	(10 44)	(16 40)	20.1	14.4
15	(5 33)	3 40	10 16	10 31	17 07	22.0	13.2
"	5 57	4 26	10 17	(10 53)	(16 44)	20.4	15.4
16	(6 21)	4 07	- - - - -	10 10	- - - - -	22.1	- - -
"	6 46	- - - - -	- - - - -	- - - - -	- - - - -	- - -	- - -
17	(7 12)	- - - - -	- - - - -	- - - - -	- - - - -	- - -	- - -
"	7 38	6 35		(11 23)		22.2	
18	(8 05)	7 01	0 25	11 23	(17 13)	20.4	15.5
"	8 33	7 57	0 46	(11 52)	17 08	22.1	13.7

Series II. June and July, 1861.—*Continued.*

Date.	Moon's upper and lower transit.	Time of high water.	Time of low water.	Lunitidal interval of high water.	Lunitidal interval of low water.	Height of high water.	Height of low water
June 19	(9^h 03^m)	7^h 52^m	1^h 52^m	11^h 19^m	(17^h 47^m)	20ft.5	15ft.3
"	9 33	8 53	1 38	(11 50)	17 05	23.1	13.7
20	(10 03)	8 54	- - - -	11 21	- - - - -	20.5	- - -
"	10 34	9 44	2 34	(11 41)	17 01	23.8	13.8
21	(11 05)	9 50	3 20	11 16	(17 17)	20.5	14.6
"	11 37	10 50	4 15	(11 45)	17 41	24.2	12.4
22		- - - - -	5 40	- - - - - -	(18 35)	20.9?	13.4
"	(0 07)	11 37	5 18	(11 30)	17 41	24.8	12.6
23	0 38	11 50	6 06	11 12	(17 59)	21.1	12.8
"	(1 06)		5 34		16 56		12.4
24	1 35	0 13	6 52	(11 07)	(17 46)	24.9	12.7
"	(2 00)	0 31	6 10	10 56	16 35	21.3	12.9
25	2 26	0 48	7 17	(10 48)	(17 17)	25.0	12.8
"	(2 50)	1 12	7 01	10 46	16 35	21.4	13.4
26	3 14	1 30	7 49	(10 40)	(16 59)	24.7	13.1
"	(3 37)	2 03	7 43	10 49	1[illegible] 29	21.1	13.9
27	4 00	2 17	8 46	(10 40)	(17 09)	21.1	13.5
"	(4 20)	2 40	8 10	10 40	[illegible]	21.0	14.7
28	4 40	2 24	9 05	(10 01)	(16 4[illegible])	23.2	13.9
"	(5 01)	3 18	8 58	10 38	1[illegible] 18	20.7	15.3
29	5 22	3 19	9 59	(10 18?)	(16 58)	22.5	[illegible]
"	(5 42)	4 10	9 55	10 48	[illegible]	20.7	16.4
30	6 03	4 46	10 36	(11 04)	(16 [illegible])	21.9	14.8
"	(6 24)	5 16	11 07	11 [illegible]	17 01	20.6	16.9
July 1	6 45	4 52	11 28	(10 [illegible])	(17 04)	20.4	15.2
"	(7 07)	6 29		11 14		21.0	
2	7 29	6 10	0 54	(11 [illegible])	18 09	19.8	17.2
"	(7 52)	7 [illegible]	0 40	12 17	(17 33)	21.3	15.3
3	8 15	7 [illegible]	1 51	(11 20)	18 22	19.6	17.2
"	(8 40)	[illegible]	1 42	12 27	(17 50)	21.7	15.3
4	9 05	[illegible]	2 58	(11 48)	1[illegible] 43	19.2	16.2
"	(9 30)	[illegible]	2 24	12 14	(17 44)	22.1	14.6
5	9 56	[illegible] 20	3 55	(11 50)	18 50	19.5	15.6
"	(10 23)	[illegible] 06	3 21	12 10	(17 51)	23.9	14.4
6	10 50	[illegible] 17	- - - -	(11 54)	- - - - -	21.4	- - -
"	(11 17)	[illegible] 43?	5 58	11 53?	(17 35)	23.4?	15.4
7	11 44	[illegible] 54	5 14	(11 37)	18 24	20.4	14.3
"		[illegible] 16	4 35	11 32	(17 18)	24.3	13.7
8	(0 10)	[illegible] 33	5 47	(11 25)	18 03	20.7	13.7
"	0 37		5 23		(17 13)		13.0
9	(1 02)	0 04	6 24	11 27	17 47	24.3	12.9
"	1 28	0 05	6 05	(11 03)	(17 03)	20.6	12.4
10	(1 53)	0 31	6 21	11 03	16 53	24.0	13.5
"	2 18	1 02	6 37	(11 09)	(16 44)	21.3	13.1
11	(2 42)	0 58	7 31	11 40	17 13	24.[illegible]	12.4
"	3 07	1 28	7 19	(10 46)	(16 37)	21.2	12.9
12	(3 31)	1 49	8 04	10 42	16 57	23.7	12.0
"	3 55	- - - - -	- - - -	- - - - -	- - - - - -	- - - -	- - -

Half-monthly Inequality.—The theoretical formula for the half-monthly inequality *in time* is, according to the equilibrium theory,

$$tan\ 2\theta' = -\frac{h\ sin\ 2\phi}{h' + h\ cos\ 2\phi}$$

where h and h' represent the elevations of the spheroid due to the sun and moon respectively, ϕ the angular distance of the moon from the sun, and θ' the angular distance of the pole of the spheroid (or of high water) from the moon's place. In reality, however, the pole of this spheroid follows the moon at a certain distance, the mean value λ' of which is known as the "mean establishment," and which corresponds to a distance of the sun and moon of $\phi-\alpha$ instead of ϕ. This retroposition of the tide, which is mostly the effect of friction, has been called the "age" of the tide.

The above formula, in conformity with the wave theory, then assumes the form

$$tan\ 2\,(\theta'-\lambda') = -\frac{h\ sin\ 2\ (\phi-\alpha)}{h' + h\ cos\ 2\ (\phi-\alpha)}$$

the mean establishment λ', the ratio of the solar and lunar effect $\frac{h}{h'}$ and the angle of retardation α are to be determined from the observations.

The theoretical expression for the half-monthly inequality in *height* is, according to the equilibrium theory,

$$y = \sqrt{(h'^2 + h^2 + 2h'\,h\ cos\ 2\phi)}$$

where y represents the height of the pole of the equilibrium spheroid above the undisturbed mean level of the surface, this expression must be changed, in accordance with the wave theory, into the following[1]

$$y = \sqrt{\left(h'^2 + h^2 + 2\,h'\,h\,cos\ 2\ (\phi-\alpha)\right)}$$

the values of h', h and α must be found from the observations.

In order to compare our observations with these theoretical expressions the lunitidal intervals and heights of Table II were first arranged according to the time of the moon's transit; the total number of observations being comparatively small, the results by the two series were at once united, for which purpose the heights of the second series were all diminished by 1.2 foot to reduce them to the same plane of reference. No distinction was made between upper and lower transits. For the high waters as well as for low waters twelve groups of lunitidal intervals and corresponding heights were formed, and the values of each group, extending over one hour, were united into a mean, of which process the following is an example:—

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[1] Art. (535) Tides and Waves. $tan\ 2\ (\theta-\lambda) = -\frac{S''\ sin\ 2\ (m-s-a)}{M'' + S''\ cos\ 2\ (m-s-a)}$ and

$$y = \sqrt{\left(M'''^2 + 2\,M'''\ S'''\ cos\ 2\ (m-s-a) + S'''^2\right)}$$

For Moon's Transit between 2 and 3 hours.

First Series.

☾'s transit.	Lun. interval for high water.	Height of high water.	☾'s transit.	Lun. interval for low water.	Height of low water.
2^h 15^m	10^h 30^m	$23^{ft}.3$	2^h 15^m	17^h 25^m	$12^{ft}.3$
(2 42)	(10 18)	(19.7)	(2 42)	(16 03)	(12.2)
(2 22)	(10 38)	(23.0)	(2 22)	(16 53)	(12.0)
2 48	10 57	19.2	2 48	16 27	12.3
Second Series.					
(2 16)	(10 37)	(19.1)	(2 16)	(16 28)	(12.4)
2 42	10 42	22.4	2 42	17 18	11.8
(2 00)	(10 48)	(23.8)	(2 00)	(17 17)	(11.6)
2 26	10 46	20.2	2 26	16 35	12.2
(2 50)	(10 40)	(23.5)	(2 50)	(16 59)	(11.9)
2 18	10 40	23.3	2 18	17 13	10.9
(2 42)	(10 46)	(20.0)	(2 42)	(16 37)	(11.7)
Mean, 2 29	10 40	21.6	2 29	16 50	11.9

The greater the number of values the more will the *uncompensated* part of diurnal inequality, declination effect, and parallax effect, disappear from the mean results. No observation was rejected.

The following table contains the mean hourly values for the high waters and low waters:—

For high water.			Number of observations.	For low water.			Number of observations.
☾'s transit.	Lun. int'l.	Height.		☾'s transit.	Lun. int'l.	Height.	
0^h 27^m	11^h 17^m	$21^{ft}.7$	11	0^h 27^m	17^h 24^m	$11^{ft}.8$	11
1 29	10 59	21.3	12	1 29	17 02	11.9	12
2 29	10 40	21.6	11	2 29	16 50	11.9	11
3 29	10 35	21.2	12	3 28	16 45	12.5	11
4 28	10 28	20.2	13	4 28	16 31	13.3	13
5 30	10 50	19.7	13	5 27	16 52	13.6	11
6 30	11 09	19.3	8	6 26	17 10	14.3	11
7 26	11 45	19.3	13	7 26	17 44	14.2	13
8 22	11 49	19.8	10	8 21	18 10	13.1	8
9 30	11 54	20.4	9	9 30	17 53	12.8	8
10 29	11 47	20.9	8	10 29	17 51	12.6	9
11 28	11 33	21.2	11	11 25	17 42	11.9	11
Mean.	11 13.8	20.5			17 19.5	12.8	

From this and the preceding table we find:—

Height of average high water level . . . . 20.5 feet

Height of average low water level . . 12.8 feet

Hence average rise and fall of tide 7.7 feet; at Van Rensselaer Harbor this quantity was 7.9 feet.

Height of highest high water level	24.6 feet
Height of lowest high water level	17.3 feet

Hence extreme fluctuation in high water level 7.3 feet; at Van Rensselaer Harbor the corresponding quantity was 8.4 feet.

Height of highest low water level	16.0 feet
Height of lowest low water level	10.8 feet

Hence extreme fluctuation in low water level 5.2 feet; at Van Rensselaer Harbor the corresponding quantity was 9.0 feet.

The extreme fluctuation in the water level observed was 13.8 feet; at Van Rensselaer Harbor this quantity was 16.6 feet.

The mean establishments at the two places compare as follows:—

Mean establishment of high water at Port Foulke,	11^h	$13^m.8$	
Mean establishment of high water at Van Rensselaer Harbor,	11	43.3	Diff. $29^m.5$
Mean establishment of low water at Port Foulke,	17	19.5	
Mean establishment of low water at Van Rensselaer Harbor,	17	48.0	Diff. $28^m.5$

The determination of the constants in the formula for half-monthly inequality, *in time*, is as follows:—

For high water: By interpolation, the mean interval occurs at $0^h\ 38^m.4$, hence $\alpha = 9°\ 36'$

For low water: By interpolation, the mean interval occurs at $0\ \ 42.0$, hence $\alpha = 10\ \ 30$

For high water: By a graphical process the greatest range in the interval is $1^h\ 25^m = 21°\ 15'$ its sine[1] is 0.3624

For low water: By a graphical process the greatest range in the interval is $1^h\ 26^m = 21°\ 30'$ its sine is 0.3665

The mean establishment for high water $\varkappa' = 11^h\ 13^m.8 = 168°\ 27'$

The mean establishment for low water $\quad 17\ \ 19.5 = 259\ \ 52\frac{1}{2}$

We have consequently the following expressions:—

From 131 observed high waters,

$$tan\ 2\,(\theta' - 168°\ 27') = -\frac{0.3624\ sin\ 2\,(\phi - 9°\ 36')}{1 + 0.3624\ cos\ 2\,(\phi - 9°\ 36')}$$

and from 129 observed low waters

$$tan\ 2\,(\theta' - 259°\ 52\tfrac{1}{2}') = -\frac{0.3665\ sin\ 2\,(\phi - 10°\ 30')}{1 + 0.3665\ cos\ 2\,(\phi - 10°\ 30')}$$

By means of these expressions the inequality *in time* has been computed, the agreement with observation is shown in the following table, also by the two diagrams in which the observed quantities are indicated by dots.

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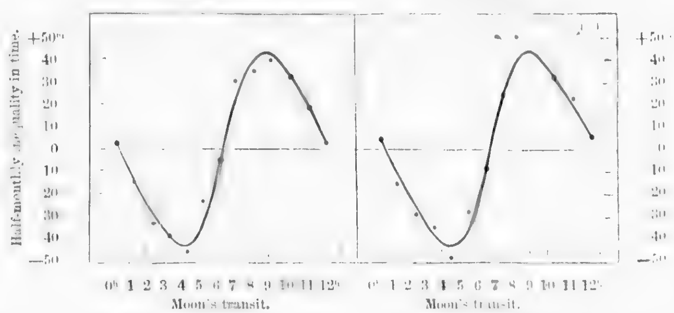
[1] In the manner in which $\frac{h}{h'}$ is deduced above it is preferable to use the sine instead of the tangent, as by Mr. Lubbock's process. See also Phil. Trans. 1836 (4th series of papers on Tides), by the Rev. W. Whewell.

Half-monthly inequality in time							
In high water.				In low water.			
☾'s transit.	Observed.	Computed.	Difference.	☾'s transit.	Observed.	Computed.	Difference.
0^h 27^m	+ 3^m	+ 3^m	0^m	0^h 27^m	+ 4^m	+ 4^m	0^m
1 29	—15	—13	—2	1 29	—17	—12	— 5
2 29	—34	—28	—6	2 29	—29	—27	— 2
3 29	—39	—39	0	3 28	—35	—38	+ 3
4 28	—46	—42	—4	4 28	—48	—43	— 5
5 30	—24	—32	+8	5 27	—28	—35	+ 7
6 30	— 5	— 5	0	6 26	— 9	— 9	0
7 26	+31	+24	+7	7 26	+24	+23	+ 1
8 22	+35	+40	—5	8 21	+50	+40	+10
9 30	+40	+41	—1	9 30	+34	+41	— 7
10 29	+33	+32	+1	10 28	+32	+33	— 1
11 28	+19	+18	+1	11 25	+22	+20	+ 2

The comparison is shown to better advantage in the diagrams.

For high water. For low water.



The range of this inequality amounts to 1^h 26^m for either the time of high or of low water; this is about a normal value. At Van Rensselaer Harbor it amounted, however, to the unusually large value of 1^h 52^m.

The determination of the constants for the half-monthly inequality in *height* is as follows: First, for the retard; the epoch of the highest and lowest reading of high water differs from that of the syzygy and quadrature, on the average by 52^m, hence $\alpha = 13°$, similarly the epoch of the extreme readings of low water differs nearly 32^m, hence $\alpha = 9°$. Second, for the range; the inequality in the height of high water is 2.4 feet; half of this, or 1.2 is the coefficient: the inequality in the low water is 2.5 feet; its coefficient, therefore, 1.25. The mean of all the heights of high water being 20.55, and of all the heights of low water 12.83, we have at once the approximate expressions for the half-monthly inequality in height, for the high waters

$$y = 20.55 + 1.2 \cos 2 (\phi - 13°)$$

for the low water

$$y = 12.83 - 1.25 \cos 2 (\phi - 9°)$$

This form was also used by Mr. Whewell (Phil. Trans. 1834, Art. II) as a first approximation, and was applied by me to the Van Rensselaer Harbor tides. For short series it is quite sufficient, and in the present case the results found by it and by the more rigorous form given below hardly differ by as much as one inch in the extreme.

To find the ratio of the solar and lunar tide we have the greatest or spring tide range, $21.7 - 11.8 = 9.9$ feet, and the least or neap tide range, $19.3 - 14.3 = 5.0$ feet; the former being the sum, the latter the difference;

$$\text{hence the ratio } \frac{2.45}{7.45} = 0.329$$

For substitution in our formula given at the head of this article, we take for h the half of the difference between the highest and lowest high water, or the difference between the highest and lowest low water, which is 1.22, the corresponding h', by means of the above ratio, is 3.72, hence the expression

$$\sqrt{\left[3.72^2 + 1.22^2 + 2 \times 3.72 \times 1.22 \cos 2 (\phi - 13^\circ)\right]} \text{ and}$$

computing the inequality by this expression the mean of all the ordinates will be found $= 3.81$, which constant we subtract to obtain the inequality itself; we have therefore for high water the half-monthly inequality

$$y = \sqrt{\left[15.33 + 9.1 \cos 2 (\phi - 13^\circ)\right]} - 3.81$$

and for low water

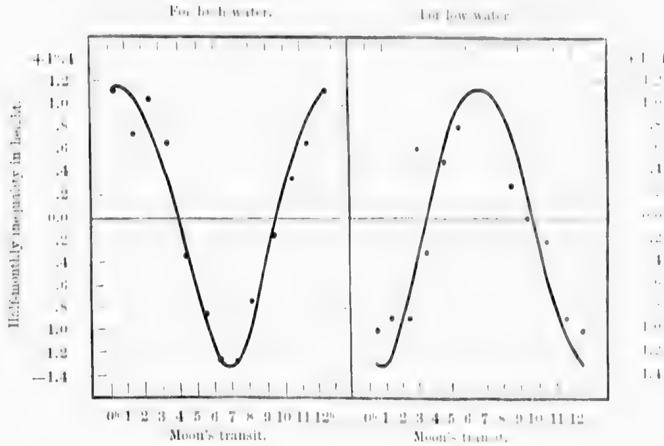
$$y = \sqrt{\left[15.33 - 9.1 \cos 2 (\phi - 9^\circ)\right]} - 3.83$$

The comparison between observed and computed heights is shown in the following table and by diagrams. The observed inequality was found by subtracting the mean of the whole from each single value. The results computed by the approximate formulæ are marked "app.;" those by the more rigorous formulæ are marked "rig."

Half-monthly inequality in height

In high water.					In low water.				
☾'s tran.	Observed.	Computed app.	Computed rig.	Difference.	☾'s tran.	Observed.	Computed app.	Computed rig.	Difference.
$0^h\ 27^m$	$+1^{ft}.15$	$+1^{ft}.17$	$+1^{ft}.11$	$0^{ft}.0$	$0^h\ 27^m$	$-1^{ft}.0$	$-1^{ft}.2$	$-1^{ft}.3$	$+0^{ft}.3$
1 29	+0.75	+1.14	+1.09	—0.3	1 29	—0.9	—1.1	—1.1	+0.2
2 29	+1.05	+0.79	+0.81	+0.2	2 29	—0.9	—0.7	—0.6	—0.3
3 29	+0.65	+0.24	+0.33	+0.3	3 28	—0.3	—0.1	0.0	—0.3
4 28	—0.35	—0.37	—0.27	—0.1	4 28	+0.5	+0.5	+0.6	—0.1
5 30	—0.85	—0.91	—0.90	0.0	5 27	+0.8	+1.0	+0.9	—0.1
6 30	—1.25	—1.18	—1.28	0.0	6 26	+1.5	+1.3	+1.1	+0.4
7 26	—1.25	—1.15	—1.24	0.0	7 26	+1.4	+1.1	+1.0	+0.4
8 22	—0.75	—0.85	—0.83	+0.1	8 21	+0.3	+0.8	+0.7	—0.4
9 30	—0.15	—0.23	—0.12	0.0	9 30	0.0	+0.1	+0.1	—0.1
10 29	+0.35	+0.38	+0.46	—0.1	10 29	—0.2	—0.6	—0.5	+0.3
11 28	+0.65	+0.89	+0.89	—0.2	11 25	—0.9	—1.0	—1.0	+0.1

The low waters are not as well represented as the high waters.



The range for inequality is the same for high and low waters, waereas at Van Rensselaer Harbor the latter was considerably greater; the more rigorous expressions for the half-monthly inequality for this place are[1]

For high water $y = \sqrt{\left[18.25 + 12.0 \cos 2 (\phi - 15^\circ)\right]} - 4.14$

For low water $y = \sqrt{\left[18.30 - 13.0 \cos 2 (\phi - 15^\circ)\right]} - 4.12$

[1] These equations should be substituted in the place of those given p. 71 (lines 3 and 5 from top) of the Van Rensselaer Harbor tidal discussion. The observed and computed inequality compare a follows:—

	For high water.			For low water.		
☾'s transit.	Observed.	Computed.	Difference.	Observed.	Computed.	Difference.
$0\frac{1}{2}$h	+1ft.4	+1ft.3	−0ft.1	−1ft.3	−1ft.7	+0ft.4
$1\frac{1}{2}$	+1.3	+1.3	0.0	−1.5	−1.7	+0.2
$2\frac{1}{2}$	+1.1	+1.0	+0.1	−1.0	−1.1	+0.[illegible]
$3\frac{1}{2}$	+0.4	+0.5	−0.1	−0.7	−0.3	−0.4
$4\frac{1}{2}$	−0.3	−0.3	0.0	+0.5	+0.5	0.0
$5\frac{1}{2}$	−1.1	−1.0	−0.1	+1.4	+1.1	[illegible]
$6\frac{1}{2}$	−1.6	−1.6	0.0	+1.7	+1.4	+0.[illegible]
$7\frac{1}{2}$	−1.3	−1.6	+0.3	+2.0	+1.4	+0.6
$8\frac{1}{2}$	−0.9	−1.0	+0.1	+1.1	+1.1	0.0
$9\frac{1}{2}$	−0.2	−0.2	0.0	+0.1	+0.5	−0.4
$10\frac{1}{2}$	+0.3	+0.5	−0.2	−0.8	−0.3	−0.5
$11\frac{1}{2}$	+0.9	+1.0	−0.1	−1.3	−1.1	−0.2

Comparing these remainders with those given on p. 71, and deduced from the approximate equations, it will be seen that the representation is equally good by either form

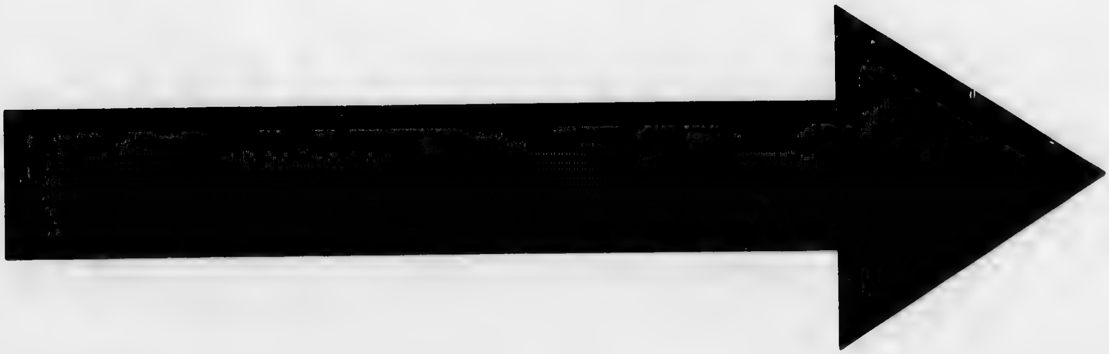


IMAGE EVALUATION
TEST TARGET (MT-3)

6"

depending on the ratio of solar to lunar tide $\frac{2.95}{7.85} = 0.376$, which is preferable to the value (0.367) given in the text (p. 71), the spring range being 10.8, and the neap range 4.9 feet, values which approximate closer to the Port Foulke results.

In the notation of Art.'s (536) to (540), Tides and Waves, we have from the time inequality, for Port Foulke $\frac{S''}{M''} = 0.364$, and from the height inequality $\frac{S'''}{M'''} = 0.329$; the heights generally give the smaller value, but that deduced from the times is theoretically the more correct one. The retard of the tide from the time-inequality is $\alpha = 10° 3'$, and from the height-inequality $\alpha = 11° 0'$, the latter is, theoretically, the preferable value. The average daily separation of the sun and moon is $48^{m}.8$; hence the time in which the moon moves through this angle or the age of the tide equals $\frac{11}{15 \times 49}$ or 0.9 of a day ($21\frac{1}{2}$ hours); by this interval the spring and neap tides follow the syzygy and quadrature respectively. The retard, as found at Port Foulke and Van Rensselaer Harbor, is comparatively small.

Effect of Changes of the Lunar Parallax on the Half-monthly Inequality.—From a short series of observations, like the one now under consideration, we can only deduce approximately the changes which the half-monthly inequality undergoes in consequence of variations in the lunar parallax, and the same remark applies to the changes produced by variations in the moon's declination. The method followed in this discussion is nearly the same for the parallactic and declination effects, and applies for high and low water and for times and heights. The luni-tidal intervals and corresponding heights were rearranged with reference to small and large values of the parallax; it is, however, not the parallax belonging to the epoch of high or low tide which was employed, but one anterior to that time, the retroposition depending on the retard of the tide as determined in the preceding article. As the average age amounts to nearly a day, the parallax preceding the effect by that interval was used in the tabulation. No distinction is required for upper or lower transits. The first group consists of intervals and heights for parallax between 54′ and 57′, the second for parallax between 57′ and 60′. The means being taken for each hour of the moon's transit, the following tables were obtained. The letter P stands for parallax; the inequality for the average parallax (57′) is added from the preceding investigation.

Table III.—Lunar-parallactic effect on the Half-monthly Inequality

☾'s tran.	For high water.				For low water.			
	P = 55'.2		P = 58'.8		P = 55'.5		P = 58'.7	
	Lun. int'l.	Height.	Lun. int'l.	Height.	Lun. int'l.	Height.	Lun. int'l.	Height.
$0^h\ 30^m$	$11^h\ 21^m$	$21^{ft}.5$	$11^h\ 13^m$	$21^{ft}.9$	$17^h\ 28^m$	$12^{ft}.1$	$17^h\ 19^m$	$11^{ft}.5$
1 30	11 01	21.6	10 59	21.2	17 01	12.3	17 01	11.7
2 30	10 45	20.2	10 38	22.1	16 44	12.1	16 53	11.9
3 30	10 34	21.3	10 36	21.1	16 52	12.6	16 40	12.4
4 30	10 36	19.8	10 16	20.7	16 45	13.7	16 31	12.5
5 30	10 53	19.6	10 44	20.0	16 53	13.8	16 51	13.3
6 30	10 52	19.1	([1]10 52)	19.7	17 14	14.5	16 59	13.8
7 30	11 52	18.9	11 28	20.1	17 53	14.7	17 23	13.2
8 30	11 56	19.6	11 38	20.3	18 26	14.0	17 53	12.3
9 30	12 06	20.2	11 38	20.7	18 11	13.0	17 23	12.6
10 30	11 54	20.9	11 28	20.9	17 58	12.8	17 39	12.2
11 30	11 32	21.1	11 34	21.4	17 36	12.0	17 52	11.7
Mean,	11 17	20.3	11 05	20.8	17 25	13.1	17 12	12.4

We have therefore for the *non-periodical* effect of the parallax in time and height the values:—

High water mean establishment.	Lunar parallax.	Low water mean establishment.	Lunar parallax.
$11^h\ 17^m$	55'	$17^h\ 25^m$	$55\frac{1}{2}'$
11 14	57	17 $19\frac{1}{2}$	57
11 05	59	17 12	$58\frac{3}{4}$
Represented by the formula $11^h\ 14^m - 3^m\ (P - 57')$		Represented by the formula $17^h\ 19\frac{1}{2}^m - 4^m\ (P - 57')$	

An *increase* of lunar parallax is followed by a *decrease* of the mean establishment for high as well as for low water.

Mean height of high water.	Lunar parallax.	Mean height of low water.	Lunar parallax.
$20^{ft}.3$	55'	$13^{ft}.1$	$55\frac{1}{2}'$
20.55	57	12.8	57
20.8	59	12.4	$58\frac{3}{4}$

An *increase* of the parallax is followed by an *increase* in the mean height, at a rate of $0^{ft}.13$ for 1' of parallactic change.

An *increase* of the parallax is followed by a *decrease* in the mean height, at a rate of $0^{ft}.2$ for 1' of parallactic change.

The range of the tide is consequently increased by $0^{ft}.3$ nearly for a parallactic increase of 1'.

For the *periodical* part we form the following table by subtraction of the mean values in Table III.

[1] Interpolated, number of observations insufficient.

	Inequality in high water.						Inequality in low water.					
☾'s tran.	P=55′	57′	59′	P=55′	57′	59′	P=55¼′	57′	58¾′	P=55½′	57′	58½′
0^h 30^m.	+ 4^m	+ 3^m	+ 8^m	+1^{ft}.2	+1^{ft}.1	+1^{ft}.1	+ 3^m	+ 5^m	+ 7^m	—1^{ft}.0	—1^{ft}.0	—0^{ft}.9
1 30	—16	—15	— 6	+1.3	+0.8	+0.4	—24	—17	—11	—0.8	—0.9	—0.7
2 30	—32	—34	—27	—0.1	+1.0	+1.3	—41	—30	—19	—1.0	—0.9	—0.5
3 30	—43	—39	—29	+1.0	+0.7	+0.3	—33	—34	—32	—0.5	—0.3	0.0
4 30	—41	—46	—49	—0.5	—0.3	—0.1	—40	—49	—41	+0.6	+0.5	+0.1
5 30	—24	—24	—21	—0.7	—0.9	—0.8	—32	—27	—21	+0.7	+0.8	+0.9
6 30	—25	— 5	—13	—1.2	—1.2	—1.1	—11	—10	—13	+1.4	+1.5	+1.4
7 30	+35	+31	+23	—1.4	—1.3	—0.7	+28	+24	+11	+1.6	+1.4	+0.8
8 30	+39	+35	+33	—0.7	—0.7	—0.5	+61	+51	+41	+0.9	+0.3	—0.1
9 30	+49	+40	+33	—0.1	—0.2	—0.1	+46	+33	+11	—0.1	0.0	+0.2
10 30	+37	+33	+23	+0.6	+0.3	+0.1	+33	+32	+27	—0.3	—0.2	—0.2
11 30	+15	+19	+29	+0.8	+0.7	+0.6	+11	+22	+40	—1.1	—0.9	—0.7
Range,	87	84	76	2.7	2.5	2.1	90	84	76	2.7	2.6	2.3

The ranges of the inequality for time and height were taken from a graphical process to free them from the incidental irregularities of the tabular numbers.

As the parallax *increases* the range of the inequality in time for high and for low water *decreases* at the rate of nearly 3^m for high water, and of nearly 4^m for low water, for each minute of change of parallax.

With respect to the inequality range in height an *increase* of parallax is followed by a *decrease* in the range for high and low water; this latter result, however, I do not think as fully established.

The parallactic results for Liverpool and London (Phil. Trans. 1836) accord, upon the whole, quite well with those given above for Port Foulke; only results for high water[1] are given.

The variations in the *retard* of the tide depending on variations of parallax were made out by means of a graphical process; it appears that for *increasing* parallax the angle α *increases* for high and low water at a rate of about 3^m for each minute of parallactic change. This accords also well with the Liverpool result.

Effect of Changes of the Moon's Declination on the Half-monthly Inequality.—The effect of the declination changes may be found by the use of the same method as that employed in the parallactic investigation, but as the declination effect varies as the *square* of the declination, the greater the number of groups, arranged for declinations between 0° and ±26°, the more reliable will be the result. Our short series will not permit the formation of even two full groups, the first comprising declinations between 0° and ±16°, the second between ±16° and ±26°. The moon's declination *preceding* the effect by one day has been employed. It was found necessary to contract the tabulation of the half-monthly inequality from 12 to 6 values; for transits near 1^h and 11^h only high declinations occur; for transits near 7^h only low ones; no results could therefore be inserted for these hours. D stands for declination.

[1] Far less attention has hitherto been given to the laws of low water than to those of high water; the latter are *practically* of greater importance, but *theoretically* there is no difference in their value.

Lunar-declination effect on the Half-monthly Inequality

☾'s tra.	High water. Inequality in time. D = +8°	+16°	±23°	Low water. Inequality in time. D = +8°	+16°	+23°	High water. Inequality in height. D +8	+16°	+23°	Low water. Inequality in height. D +8	+16	+23
1^h	- - - -	$11^h 08^m$	- - - -	- - - -	$17^h 13^m$	- - - -	- - -	21^{ft}.5	- - -	- - -	11.8	- - -
3	$10^h 41^m$	10 37	$10^h 36^m$	$16^h 49^m$	16 18	$16^h 47^m$	21^{ft}.4	21.4	21^{ft}.3	12^{ft}.2	12.3	12^{ft}.2
5	10 40	10 39	10 33	16 46	16 42	16 44	20.0	20.0	20.2	13.4	13.4	13.5
7	- - - -	11 27	- - - -	- - - -	17 27	- - - -	- - -	19.3	- - -	- - -	14.2	- - -
9	11 46	11 52	(11 57)?	18 18	18 01	17 52	20.0	20.1	20.2	12.7	13.0	13.2
11	- - - -	11 40	- - - -	- - - -	17 46	- - - -	- - -	21.0	- - -	- - -	12.2	- - -
Mean,		11 14			17 19½			20.6			12.8	

From the above compilation we can infer that for *increasing* declination the *non-periodical* part of the half-monthly inequality *decreases*; this applies to the times of high and of low water; the total range between 0 and ±26° probably amounts to a few minutes. Respecting the heights, an *increase* of the moon's declination probably produces a *decrease* (in the non-periodic part) of the height of high water, and certainly an *increase* in the height of low water; the range, therefore, will diminish with an increase of declination. The total range between zero and maximum declination probably amounts to a fraction of a foot.

The periodical and epochal part of the declination effect cannot be investigated on account of an insufficiency of material; for the same reason we are compelled to omit any discussion of the effect of changes of the solar declination and parallax, which would demand a series of observations extending at least over one year.

Investigation of the Diurnal Inequality.—The phenomenon of *alternate* higher and lower high waters and *alternate* higher and lower low waters, also *alternate* earlier and later high or low waters, is known as that of the diurnal inequality. Its cycle is a lunar day, and as its magnitude depends on the moon's declination, it goes through its phases in about 14 days, or half a lunation. Generally speaking, and without reference to retard, this inequality vanishes when the moon passes the equator, and reaches its greatest development when the moon attains its greatest north or south declination. The full effect is not generally reached until several days after the moon has passed these positions. The high waters alone may be principally affected, or the low waters alone, or both may exhibit the inequality. Part also of this diurnal tide depends on the sun, and appears therefore in certain months of the year more distinct, and in other months less so. The tidal theories agree in assigning a large diurnal inequality to the middle latitudes, and a small one to equatorial and polar latitudes, the existence of the diurnal inequality in Baffin Bay, along the west coast of Greenland, has long been known to navigators, and by the labors of Dr. Kane it has been traced beyond Smith Strait as far up as latitude 78½° N. The present series not only confirms these results but gives us by far the better special knowledge of the various features of the phenomenon. The diurnal inequality experienced in these high latitudes is evidently the result of the propa-

gation of the diurnal wave through the Atlantic Ocean and up Baffin Bay. We shall now enter more fully into the phenomena, and commence with the

Diurnal Inequality in Height.—On Plate I the observed tides of the winter and summer series have been laid down graphically in time and height; this was done directly from the numbers of Table II. The few wanting tides were interpolated, and are shown by dots. The high waters, depending on the moon's *upper* transit, as well as the low waters *following*, which depend on the same transit, are distinguished from those high and low waters which follow the moon's *lower* transit, by a simple dot at their extremity; whereas the latter have a small circle attached. To render the diurnal inequality more conspicuous, the dots of the high and of the low waters were each connected by a full line, and the circles by lines of dashes.

The vertical distances between this full line and the line of dashes are re-plotted on a straight axis (of abscissæ) and exhibited below each series of observations, the first for high, the second for low water. On the same axis zero declination (of the moon) is indicated by a small circle, and greatest north or south declination by a small bar. The diurnal inequality in height is greater for the high waters and less for the low waters, and that *high* water which follows the moon's *upper* transit (about 11 hours) when she has *north* declination is the higher of the two of that day;[1] when, on the contrary, she has *south* declination, it will be the lower of the two. The same rule was found from the Rensselaer Harbor tides. For the low waters the rule cannot conveniently be stated in this form owing to a remarkable circumstance, namely, the *simultaneous* occurrence of *no* inequality in the *high* waters with *greatest* inequality in the *low* waters, and consequently also the occurrence of the greatest high water inequality with no inequality in the low waters; this is very plainly shown in the diagrams on Plate I. This singular feature has heretofore, as far as known to me, not been found for any station on the Atlantic, or depending on this ocean for its tides; but it was detected in Puget Sound on the Pacific, which the reader will find noticed in the reports of the Superintendent of the U. S. Coast Survey for the year 1859 (p. 144), and in three subsequent reports. The rule, however, which applies there to the height of high water applies at Port Foulke to the low water, and vice versa.

The apparent retard of the high water epoch is as follows:—

	☾'s declination zero.			Inequality vanishes.	Interval.
1860.	Nov.	22d,	0h A. M.	23d 0h P. M.	1d 12h
	Dec.	5,	11 P. M.	7 6 P. M.	1 19
	"	19,	7 A. M.	21 6 P. M.	2 11
1861.	June	15,	7 A. M.	16 4 P. M.	1 9
	"	28,	7 A. M.	30 6 P. M.	2 11

On the average, therefore, the diurnal inequality in the height of high waters disappears 1.9 day after the moon's passage over the equator; the corresponding quantity at Van Rensselaer Harbor was 1.6 day.

[1] This rule depends also on the particular transit of the moon first fixed upon to connect with the tide, and the desirability of extending the establishment beyond twelve hours; thus the rule for high water, given by the Rev. W. Whewell for our Atlantic coast (6th Series of Tidal Researches, Phil. Trans. 1836) will be found the opposite of that given in our U. S. Coast Survey Reports for the Pacific coast of the United States. Port Foulke follows the rule of the latter.

The apparent retard of the low water epoch is as follows:—

	☾'s declination zero.	Inequality vanishes.	Interval.
1860.	Nov. 22^d, 0^h A. M.	Dec. 1^d 6 P. M.	9^d 18^h
	Dec. 5, 11 P. M.	" 16 0 A. M.	10 1
1861.	June 1, 0 A. M.	June 11 4 A. M.	10 4
	" 15, 7 A. M.	" 24 0 A. M.	8 17
	" 28, 7 A. M.	{ July 7 0 A. M. / " 10 6 P. M. }	10 11

On the average, therefore, the diurnal inequality in the height of low water disappears 9.8 days after the moon's passage over the equator.

This difference in the epoch of the inequality in the height of high and low water, amounting to 7.9 days, is significant. With respect to the retard we remark, generally, for tidal waves that their oscillations are augmented by the continued action, in the same direction, of the force having the same intervals as those oscillations; they will, therefore, go on increasing for a considerable time after the forces have gone on diminishing; here the retard is due to an accumulated effect. It is plain that this explanation cannot apply to the epoch of the diurnal wave which shows an epochal difference of nearly eight days for high and low water, but must be the effect of *interference* of the diurnal and semi-diurnal wave. The subject of separation of these two waves will be taken up and analyzed further on.

By means of the diagrams on Plate I we find the maximum range of the diurnal inequality in height for high water to be 3.8 feet, determined from five cases, each giving the same amount. For the low water diurnal inequality range the values are more variable; they are 2.0, 3.7, 2.3, 2.2, and 2.0 feet, on the average 2.4 feet. The last three values belong to the summer series, and are probably affected by the solar action. The variations in the moon's parallax also affect the diurnal inequality, and there are indications of an increase for a larger parallax; our series, however, are too short to pursue this subject any further.

According to Sir J. Lubbock (Phil. Trans. 1837) the lunar portion of the diurnal inequality can be represented by

$$dh = C \sin 2\delta' \text{ for the heights, and } d\psi = \frac{G \tan \delta'}{1 + A \cos 2\phi} \text{ for the times.}$$

In these expressions the value of δ' must be taken for an anterior date, which for the high water height inequality in our case is two days. Dividing the intervals between the moon's zero declination in six equal parts, and measuring for each the ordinate of the inequality and tabulating the corresponding declinations, without regard to sign, we obtain the following results for the inequality in height of high water from the two series. Each value is the result of five separate measures, and the computed value is derived from the expression $dh = 4.6 \sin 2\delta'$.

δ'	Observed dh	Computed dh
0°	$0^{ft}.0$	$0^{ft}.0$
12	1.8	1.9
22	3.2	3.2
25	3.5	3.5
22	3.1	3.2
12	1.8	1.9
0	0.0	0.0

The inequality in the heights of low water cannot be expressed in this manner, as the more complex figure on Plate I sufficiently indicates.

That low water which follows the moon's upper transit (about 17 hours) when she has north declination is the lower of the two, provided it happens ten days after the zero declination; if before, it is the higher of that day. A similar restriction, of two days only, applies to the rule for the highest high water.

Diurnal Inequality in Time.—The inequality in time is best exhibited by means of diagrams, the abscissæ of which are the times of high or low water, and the ordinates the corresponding lunitidal intervals, both taken from Table II. Lunitidal intervals from the upper transits are indicated by dots; intervals from the lower transits by small circles. The observations of the winter series proved somewhat too rough for the elucidation of this inequality—they were taken every half hour; the diurnal inequality, nevertheless, is sufficiently indicated to make out its general law. I shall here confine this investigation to the second series, for which we have observations every ten minutes; the results are given on Plate II for high water and low water separately. The inequality, proper, is shown underneath, where the middle line between the full and broken curves of inequality is straightened out and forms the axis of abscissæ, upon which the time inequalities, as ordinates, have been plotted. From these curves we find the retard of the time inequality for high water from three intersections with the axis equal 11.0 days, and that of low water equal 2.2 days. A comparison of these time-curves of Plate II with the height-curves of Plate I, indicates a strong similarity in character between the *height* inequality of *high* water and the *time* inequality of *low* water; for these curves the average epoch is two days, and the alternation each semi-lunation of the signs or full curves *above* and *below* the axis correspond; a similar correspondence of epoch, which is on the average 10.4 days, and of alternation of the signs exists in the time inequality of high water and the height inequality of low water. This is not an accidental relation, but has been recognized at other stations, the first and conspicuous notice of it I find in the U. S. Coast Survey Report for 1853, p. *79 in the tidal discussion by A. D. Bache, Superintendent, of Rincon Point, San Francisco, California.

The greatest range of the time inequality is for the high waters 46^m, and for the low waters 58^m, the first from two, the last from three determinations.

Respecting the relative magnitude of the inequality we have, on the one hand, the *smaller* time and *greater* height inequality in high water, and on the other, the *greater* time and *smaller* height inequality in low water.

A similar relation of magnitudes occurs at Rincon Point, but it is the reverse of that just stated, in conformity with the more prominent development of the diurnal inequality in the height of low waters in San Francisco Bay.

The interval of that high water which follows the moon's upper transit (about 11 hours) when she has north declination will be the smaller one, provided it happens 11 days after the moon's zero declination; if before, it will be the greater of the two of that day. The interval of that low water which follows the moon's upper transit (about 17 hours) when she has north declination will be the greater of the two provided it happens two days after the moon's zero declination; if before, it will be the earlier one. The reverse takes place for south declination, or for lower transit.

The time-inequality of the low water of the second series can be represented well

enough by the approximate formula $d_{☾} = .102 \tan \delta'$, the declination of the moon being taken for an anterior epoch of two days.

δ	Observed $d_{☾}$	Computed $d_{☾}$
0	0.0	0
13	12	[illegible]
22	41	41
25	48	48
21	27	40
12	24	22
0	0	0

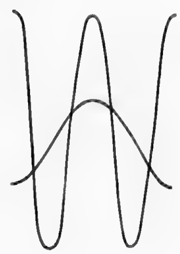
The curve thus computed is represented on Plate II; see bottom diagram. Corresponding to this curve the bottom diagram of Plate I shows the computed height inequality for high water.

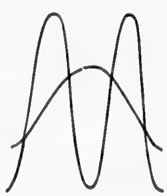
Separation of the Diurnal and Semi-Diurnal Waves.—The compound wave actually observed consists of the diurnal wave, to which the diurnal inequality is due, and of the ordinary semi-diurnal wave which produces the ordinary tides. For a complete study of these waves it is necessary to h   them in their separate forms. The manner in which this separation will be effected is the same as that employed in the U. S. Coast Survey; it was originally proposed by Assistant L. F. Pourtales, in charge of the tidal party, about the year 1855,[1] and has taken the place of the more laborious analytical process previously employed; the graphical process of Mr. Whewell's was applied only to observed high and low waters, and consequently gave but few points of the diurnal wave.[2] In Series II the high and low waters alone were observed, which renders it quite unsuitable for the purpose of separation. I was therefore obliged to select the least interrupted portion of the half-hourly observations of Series I. The compound (observed) wave, and its two component waves from November 21 to December 11, 1860, are shown on Plate III. The graphical process of separation is as follows: After the observations are plotted and a tracing is taken, the traced curves are shifted in epoch 12 hours 24 minutes *forward*, when a mean curve is pricked off exactly *between* the observed and traced curves; the same process is repeated after the paper was shifted 12 hours 24 minutes *backwards*, when a second pricked curve is obtained; the mean pricked curve then represents the semi-diurnal wave. To obtain the diurnal curve we have only to lay off the differences between the observed curve and the semi-diurnal curve. The process is simplified by blacking the under surface of the tracing paper with a lead pencil and running in with a free hand the intermediate curve by the pressure of a steel point which leaves a sufficient mark on the paper; the average of the two curves thus traced gives the semi-diurnal wave in quite an expeditious manner. Nevertheless the discussion, by separate waves, of any lengthy series of observations remains a laborious task. On Plate III the observed heights, reduced to the same plane of reference or zero level, are shown by dots, and connected by a full line; some omissions in the observations are supplied by dots; the average level reads 16.7 feet. The semi-diurnal wave is shown by a curve of dashes, and the diurnal

[1] See my discussion of the Van Rensselaer Harbor tides, p. 78, where the method is first published, by permission of A. D. Bache, Superintendent U. S. Coast Survey.

[2] See 8th Series of Researches of Tides. Phil. Trans. 1837.

wave by a full line constructed over the average level as an axis of abscissæ. The combination of the two component waves will show the features of the diurnal inequality; thus, the upper of the two annexed diagrams exhibits the position of the semi-diurnal wave on November 30, when the inequality in the height of high water is *greatest*, and when the low waters show *no* inequality since they are affected alike. On the contrary, the lower figure exhibits the position on December 8, when there is *no* inequality in the high waters, and the greatest inequality in the height of low water. In the upper case the maximum ordinates or the high waters of the two waves coincide; in the lower case they are opposed, or the high water of the diurnal wave coincides with the low water of the semi-diurnal. As the semi-diurnal wave progresses or gains on the diurnal all possible variations are gone through successively. For the upper diagram the *time* of the first low water will be earlier or its luni-tidal interval shorter, and the time of the second low water will be later, or its luni-tidal interval will be greater; the time of the intermediate high water will not be affected. For the lower diagram the time of the first high water will be later, and that of the second earlier; the interval of occurrence between these high waters will therefore be considerably shortened. The time of the intermediate low water will not be affected.





The average range of the diurnal tide for the period represented on Plate III is about three feet, and for the semi-diurnal about seven feet, the greatest and least ranges for these waves are four feet and two feet nearly for the first, and ten feet and four feet nearly for the last. The diurnal wave gradually increases in size from the time of the moon's zero declination to the time of its maximum declination, as shown on the Plate.

The epoch of the diurnal wave appears to remain sensibly the same during the twenty days for which it has been brought out; that is to say, its high water appears to occur at noon, and consequently its low water at midnight; the variations from these hours are confined within an hour before or after. The Van Rensselaer Harbor tides afforded but a bare glimpse at the diurnal tide which occurred between October 30 and November 22, 1853, there also its high water appeared to hang about the hours two or three after noon, and its low water the same number of hours after midnight; but as theory points out a different relation than that of solar time, *and consequently a gradual slow shifting from the solar hours*, and as our series is too short to show its conformity or non-conformity therewith, we are compelled to leave this interesting branch of the discussion.

Owing to the variation in the epoch of the diurnal wave, its rate of progress from Port Foulke to Van Rensselaer Harbor cannot be made out directly, since the observations were not contemporaneous, although future observations at some

southern point of Baffin Bay would probably enable us to trace its course northwards through this channel

Investigation of the Form of the Tide Waves.—The compound character of the wave requires a separate investigation of the forms of the diurnal and of the semi-diurnal wave. We have seen that the diurnal wave undergoes smaller fluctuations of range than the semi-diurnal, in which latter the spring and neap tides are fully developed. To obtain the average slope of these waves the time between two successive low waters was divided in six equal parts, for each of these phases the ordinates were measured from the low water level. The ordinates of 20 diurnal waves and of 38 corresponding semi-diurnal waves, were thus ascertained and their mean values taken. Applying to these measures Bessel's circular function[1] the average forms of these waves, from twenty days of observation, are given by the following expressions:—

For the diurnal wave

$$1^{ft}.50 + 1.56 \sin(\theta + 270^\circ) + 0.08 \sin(2\theta + 135^\circ)$$

For the semi-diurnal wave

$$3.75 + 3.79 \sin(\theta + 275^\circ) + 0.21 \sin(2\theta + 194^\circ)$$

The observed and computed values agree as follows:—

Diurnal wave.			Semi-diurnal wave.		
Observed.	Computed.	Difference.	Observed.	Computed.	Difference.
$0^{ft}.0$	$0^{ft}.0$	$0^{ft}.0$	$0^{ft}.0$	$-0^{ft}.1$	$+0^{ft}.1$
0.6	0.5	+0.1	1.9	+2.2	−0.3
2.3	2.5	−0.2	6.2	+6.1	+0.1
3.1	3.1	0.0	7.4	+7.5	−0.1
2.2	2.4	−0.2	5.3	+5.2	+0.1
0.7	0.6	+0.1	1.7	+1.8	−0.1
0.0	0.0	0.0	0.0	−0.1	+0.1

In the above expressions the angle θ counts from low water (0°) to the following low water (360°), for the first wave it passes through its values in a day nearly, for the second in twelve lunar hours; the ordinates are expressed in feet. The diurnal curve appears to be nearly symmetrical, but the preceding slope of the semi-diurnal wave appears steeper than the following slope; the difference, however, is slight.

The difference in the establishments of high and low water is $6^h\ 05^m.7$, which represents the duration of *fall*, the duration of *rise* consequently is $6^h\ 18^m.7$; the rise occupies therefore more time than the fall; the difference is 13^m. At Van Rensselaer Harbor this difference was 15^m, the water also rising longer.[2] This appears to be the rule for all localities which receive the direct ocean tide wave; the form of the wave, however, changes when ascending a *shallow* bay or a river, and reverses the duration of the tide, making the rise the shorter.

[1] Development of Bessel's function for the effect of periodic forces, etc, U. S. Coast Survey Report for 1862, Appendix No. 22.

[2] In the discussion of the Van Rensselaer Harbor tides, p. 80, the reverse is inadvertently stated

Progress of the Tide through Baffin Bay.—In the following table I have collected all the tidal information I could find respecting establishment and range of stations on the west coast of Greenland, for the purpose of showing the northerly propagation of the tide wave through Baffin Bay. This locality is well suited for testing the theoretical deductions, according to the tidal theory of canals, the bay being sufficiently regular and of great length, with the full Atlantic tide thrown into it at its southern end. Its tides will therefore be of a derivative character chiefly, since any forced tide produced in it must be, comparatively very small, and would produce waves of an undulatory character. For this purpose it would be very desirable to obtain some sets of unexceptionable tidal observations[1] on both shores of the bay, each extending over at least two lunations.

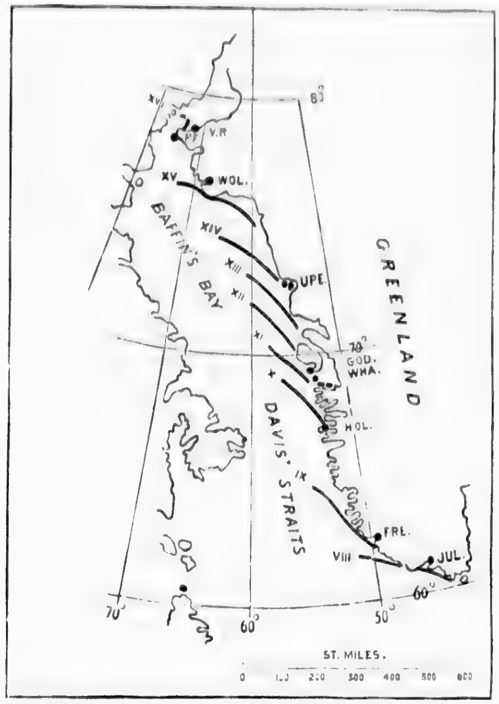
Locality.	Latitude.	Longitude west of Greenwich.	High water lunitidal interval F. and C.	Rise and fall spring tides.	Rise and fall neap tides.	Authority or reference.
Julianshaab,	60° 35′	46° 05′	5^h 6^m	7^{ft}	5^{ft}	British Admiralty Tide Tables for 1865.
Frederickshaab,	62 00	50 05	6 3	12½	9¼	
Holsteinborg,	66 56	53 42	6 30	10	—	Capt. Inglefield, 1853.
Whalefish Islands,	68 59	53 13	8 15	7½	—	Parry's Third Voyage.
Godhavn,	69 12	53 28	9 00	7½	—	Map, in Narrative of Kane's First Voyage.
Upernavik,	72 47	56 03	11 00	8	—	Capt. Inglefield, 1854.
Wolstenholm Sound,	76 33	68 56	11 08	7½	7(?)	MS. furnished by the late hydrographer to the Admiralty.
Port Foulke,	78 18	73 00	11 21	9.9	5.0	Dr. Hayes' Obser's, 1860–61.
Van Rensselaer Har.	78 37	70 53	11 52	10.8	4.9	Dr. Kane's Obser's, 1853–54.

To trace the cotidal lines or the high water ridges of the tidal wave, as it progresses, it is preferable, for comparison, to use the mean for the above vulgar establishment; 10^m were therefore subtracted from the interval at full and change. To correct for the moon's motion in the interval, 1^m is subtracted for every half hour of interval; adding the west longitude from Greenwich we obtain the corresponding Greenwich time or the cotidal hour and minute.

Locality.	Mean establishment.	Correction for ☾	Longitude.	Cotidal hour and minute.
Julianshaab	4^h 56^m	-9^m	3^h 04^m	7^h 51^m
Frederickshaab	5 53	—12	3 20	9 01
Holsteinborg	6 20	—13	3 35	9 42
Whalefish Islands	8 05	—16	3 33	11 22
Godhavn	8 50	—18	3 34	12 06
Upernavik	10 50	—22	3 44	14 12
Wolstenholm Sound	10 58	—22	4 36	15 12
Port Foulke	11 14	—23	4 52	15 43
Van Rensselaer Harbor	11 43	—23	4 44	16 04

[1] Suitable localities would be Cape Farewell, Cape St. Lewis in Labrador, Cape Walsingham, and Ponds Strait. It is to be regretted that no tidal observations were made in Kennedy Channel, as by means of these the question of its open or closed character, to the northward, could be partly answered.

These cotidal lines, which connect all places having high water at the same (Greenwich) time, are laid down on the accompanying chart.[1] The tide wave consumes very nearly eight hours in travelling from the southern cape of Greenland to Smith Sound.



Average Depth of Davis Strait, Baffin Bay, and Smith Strait.—By means of the preceding cotidal hours and the known distances of the localities in connection with the theoretical deductions of Art. (174) "Tides and Waves," we find the average depth of the sea along the channel-way as follows:—

Davis Strait. Distance from Julianshaab to Whalefish Islands 680 statute miles nearly; difference in cotidal hour $3^h.5$, hence velocity in statute miles per hour 194, and corresponding depth 2510 feet or 418 fathoms.

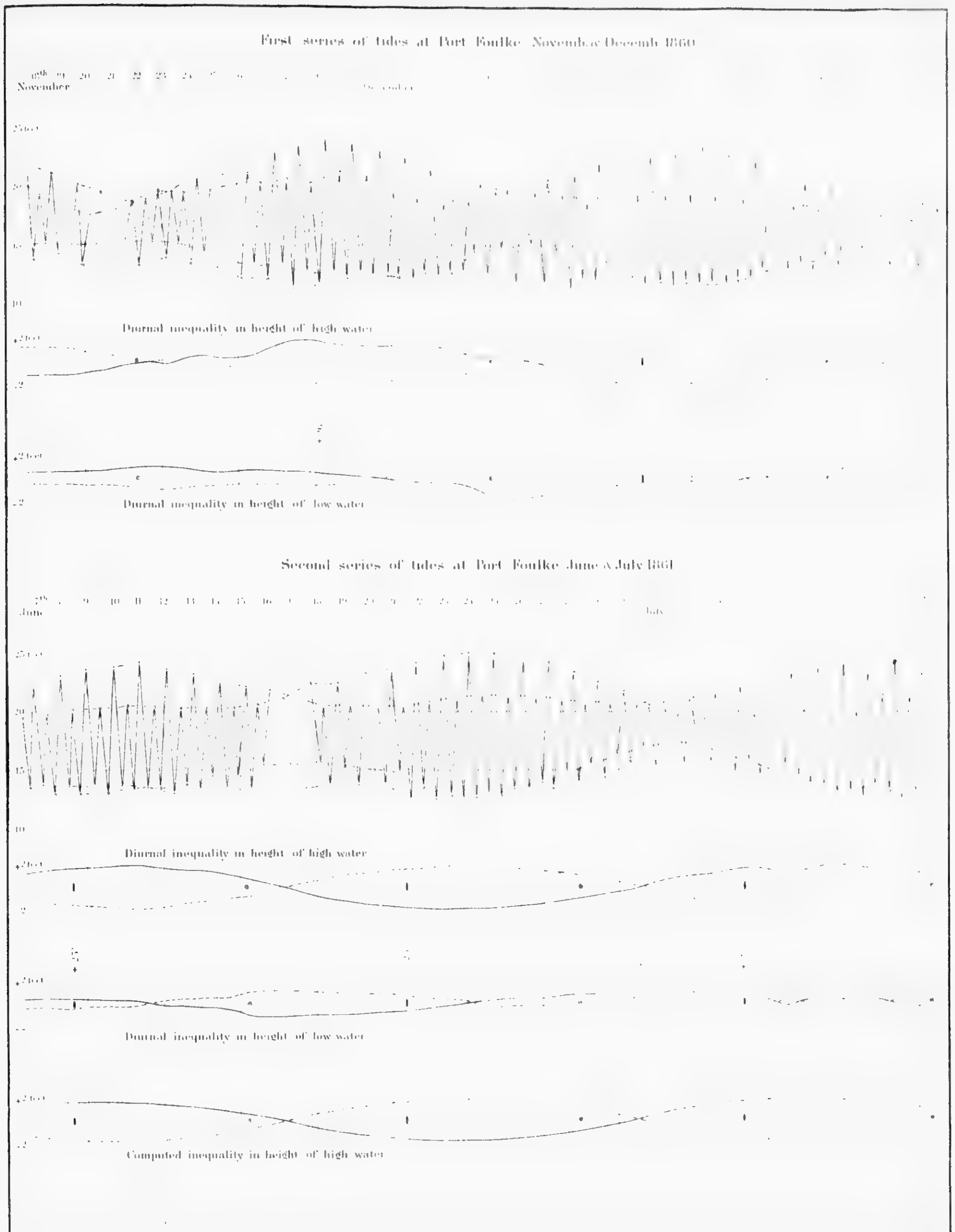
[1] The general cotidal chart constructed by Mr. Whewell, more than thirty years ago (and reproduced in the astronomer royal's essay, "Tides and Waves"), is very defective to the eastward of New Foundland, as will appear in attempting to join our cotidal lines with it; it is due to the total neglect of the powerful retarding influence of the *banks* of New Foundland.

Baffin Bay. Distance from Whalefish Islands to Port Foulke 770 statute miles nearly; difference in cotidal hour $4^h.35$; hence velocity in statute miles per hour 177, and corresponding depth 2095 feet, or 349 fathoms.

Smith Strait. Distance from Port Foulke to Van Rensselaer Harbor 55 statute miles; difference in cotidal hour $0^h.35$; hence velocity in statute miles per hour 157, and corresponding depth 1663 feet, or 277 fathoms.

The average depth, according to the above, of Davis Strait and Baffin Bay is, therefore, about 383 fathoms, the length of the free tide wave nearly 2300 statute miles, with a height between trough and crest of about $7\frac{1}{2}$ feet.

The average depth, as found from the velocity of the tide wave, appears to accord well with the few soundings we possess, and the result I consider entitled to confidence.



First series of tides at Port Foulke November & December 1860
November
Diurnal inequality in height of high water
Diurnal inequality in height of low water
Second series of tides at Port Foulke June & July 1861
June
Diurnal inequality in height of high water
Diurnal inequality in height of low water
Computed inequality in height of high water

Plate II

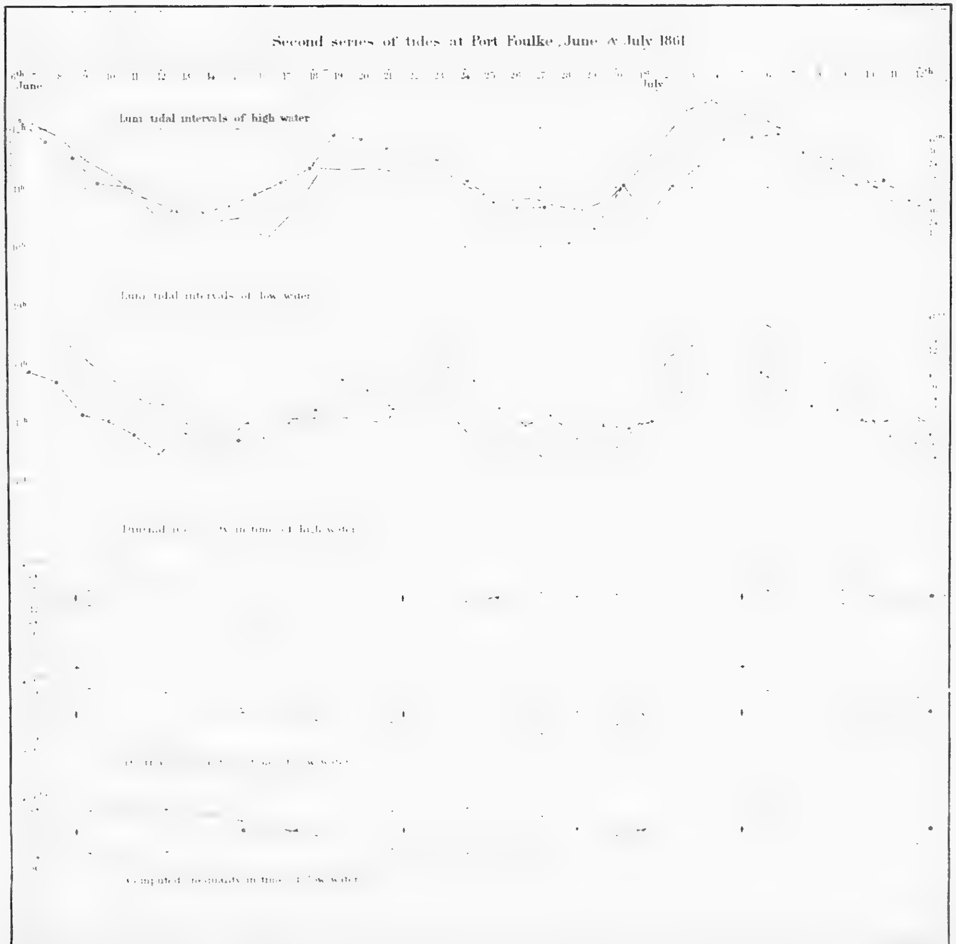
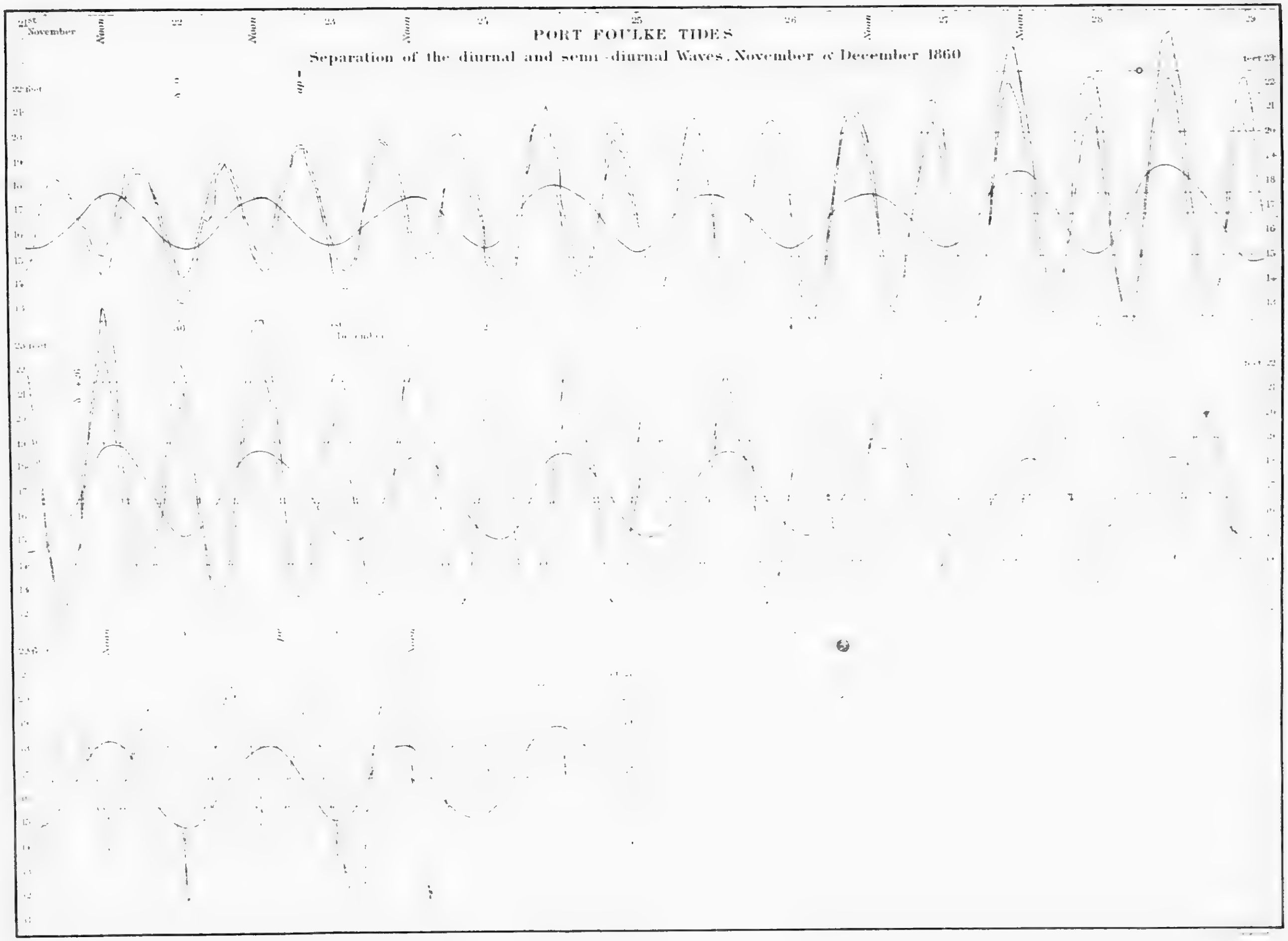

Second series of tides at Port Foulke, June & July 1861
June
July
Luni tidal intervals of high water
Luni tidal intervals of low water

Plate III

Plate III



PORT FOULKE TIDES
Separation of the diurnal and semi-diurnal Waves, November & December 1860
November
Noon

PART IV.

METEOROLOGICAL OBSERVATIONS.

RECORD AND RESULTS

OF

METEOROLOGICAL OBSERVATIONS.

The fourth and last part of the publication of the records and results of Dr. Hayes' Arctic Expedition of 1860 and 1861, herewith presented, comprises meteorology, and will be given under the subdivisions, temperature, atmospheric pressure, and wind.

By inspecting the general track chart and the special harbor chart of the winter quarters, illustrating Part I, or the astronomical results, it will be seen that Port Foulke, latitude 78° 17'.6 N. and longitude 73° 00'.0 W. of Greenwich, has a free exposure to the westward (true), directly facing Smith Strait and nearly opposite Cape Isabella. The harbor is on the south side of the entrance to a large fiord, at the eastern terminus of which is situated Lake Alida, which receives the drainage of a large glacier named by Dr. Kane "Brother John's glacier." This glacier protrudes into the upper end of the fiord and forms part of an immense mer de glace extending far into the interior, and is connected with the great Humboldt glacier. Dr. Hayes travelled over this glacier, in an easterly direction, for fifty-three miles.

The locality may be said to be, climatologically, an anomalous one, as it is fully under the immediate influence of the upper north water and the smaller water areas of Smith Strait. The sea, here, does not freeze over entirely during the winter, but presents large patches of open water which exercise a powerful influence over the climate of this region. Dr. Hayes remarked that during the winter of 1860—1861, the open sea could always be found a few miles to the westward of his anchorage. The comparative mildness of the climate makes it possible for the Esquimaux to reside habitually during the winter in this high latitude, and the vicinity of the port abounds with animal life which was almost entirely absent at Van Rensselaer Harbor, but a short distance to the northward and eastward. This contrast in the climate cannot be better illustrated than by stating the fact of the temperature simultaneously recorded on March 18, 19, 20, 21, 1861, at Port Foulke and at Van Rensselaer Harbor, then revisited by Dr. Hayes, at the former place it was —24°.7 and the latter —50°.7 as observed by him, showing a difference of not less than 26° of greater cold at Van Rensselaer Harbor.

On August 26th, 1860, Capes Alexander and Isabella were first sighted; on September 9th, at 5 P. M., the vessel was safely moored for the winter at Port Foulke,

Smith Strait; the interval between these dates was consumed in the attempt of beating in and through the strait. During this interval the climatic relations were so nearly the same as those at Port Foulke that we may conveniently commence the meteorological record with September 1, 1860. The observations extend to July 14th (10 A.M.), 1861, at which date the vessel was unmoored and pulled out of the harbor; crossing the strait, the schooner anchored for several days in the vicinity of Cape Isabella; on the 29th she was off Gale Point; and on the 31st some short distance to the southward of Cadogan Inlet. We may, therefore, combine, without much risk of error, the recorded observations during the latter half of July with the preceding record, and thus form a continuous meteorological record for Port Foulke, extending over eleven months. A proper method of interpolation will enable us to deduce a mean value for each meteorological element for the twelfth month, and the annual mean values may safely be made out.

The results will be further illustrated by comparison with those obtained from Dr. Kane's[1] and Sir F. L. McClintock's[2] expeditions, as published by the Smithsonian Institution in 1859 and 1862.

Taking the refraction into consideration, the sun's upper limb would, in the latitude of Port Foulke, astronomically disappear after October 25th noon, and reappear at noon February 15, thus remaining below the horizon for 113 days, or nearly three and two-third months. Owing to the surrounding cliffs the sun did not make its appearance at the harbor until February 18.

TEMPERATURE.

The expedition was supplied with about two dozen thermometers of different kinds, graduated according to Fahrenheit's scale, excepting two, which were divided in degrees of Reaumur. Some were spirit, others mercurial thermometers; there was also one metallic thermometer. Three of the instruments were considered of standard excellence, and of these No. 3 was selected by Mr. Sonntag as the standard, to which accordingly the indications of all others will be referred.

Thermometers Nos. 1, 2, 3, are standard instruments. No. 3 was selected as the most reliable. (They are, no doubt, spirit thermometers.)

Nos. 4, 5, 6, ordinary thermometers (supposed spirit thermometers).

Nos. 7, 9, mercurial thermometers.

Nos. 8, 10, 12, 13, ordinary thermometers.

M, a metallic thermometer by Beaumont, of New York.

1705, 1657, maximum thermometers; they are mercurial.

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[1] Meteorological Observations in the Arctic Seas, by Elisha Kent Kane, M.D., U.S.N., made during the second Grinnell Expedition in search of Sir John Franklin, in 1853, 1854, and 1855, at Van Rensselaer Harbor and other points on the west coast of Greenland. Reduced and discussed by Charles A. Schott. Smithsonian Contributions to Knowledge, 1859.

[2] Meteorological Observations in the Arctic Seas, by Sir Francis Leopold McClintock, R.N., made on board the Arctic searching yacht "Fox" in Baffin Bay and Prince Regent's Inlet, in 1857, 1858, and 1859. Reduced and discussed, at the expense of the Smithsonian Institution, by Charles A. Schott. Smithsonian Contributions to Knowledge, 1862.

1597, 1639, minimum thermometers; no doubt spirit thermometers.
1663, 1704, both mercurial thermometers; the latter a black bulb.
A, B, two Reaumur thermometers.
1644, 1648, hygrometric and black bulb thermometers.
To allow for errors of graduation the following comparisons were made:—

1. Comparisons of thermometers at the temperature of freezing water, Port Foulke, Smith Strait, September 12, 1860. The thermometers were immersed in a bucketful of melting ice. A. Sonntag, observer. The readings are taken at intervals of five minutes.

	Number or designation of thermometers.															
	3	1	2	4	5	6	7	9	1597	1639	1657	1663	1704	1705	A	B
	32°.0	31°.7	32°.0	31°.5	31°.7	31°.4	31°.0	31°.2	31°.4	32°.3	31°.2	31°.5	32°.0	32°.0	—0°.3	0°.0
	32.0	31.6	31.9	32.0	31.3	31.3	30.8	31.0	31.5	32.2	31.2	31.4	32.0	32.0	0.4	0.2
	32.0	31.5	31.8	31.8	31.5	31.3	31.0	31.0	32.0	31.7	31.5	32.0	31.5	32.0	—0.3	0.0
	32.0	31.6	31.8	32.0	31.5	31.3	31.0	31.0		32.2	31.3	31.7		32.0	—0.3	0.0
Mean,	32.0	31.6	31.9	31.8	31.5	31.3	31.0	31.0	31.6	32.1	31.3	31.7	31.8	32.0	—0.3	0.0
Corr'n,	0.0	+0.4	+0.1	+0.2	+0.5	+0.7	+1.0	+1.0	+0.4	—0.1	+0.7	+0.3	+0.2	0.0	+0.3	0.0

2. Comparisons at low temperatures, Port Foulke. The thermometers were suspended on the east side of the Port Foulke meteorological observatory, facing northeast, and were read at intervals of five minutes. March 24, 1861.

	Number or designation of thermometers.						
	3	1	2	4	9	10	M
	—37°.2	—42°.8	- - - - -	—32°.5	—32°.0	- - - - -	—35°.5
	37	42.5	- - - - -	32.2	31.8	- - - - -	35.5
	36.8	42.2	- - - - -	33	31.8	- - - - -	35
	36.8	42.2	—33°.8	33.2	31.8	—39	35.5
	36.8	42	34.5	33.5	31.8	40	35
	37	42.2	35	33.5	32.0	41.5	35.5
	37	42.5	35.5	33.8	32.0	42	36
Mean,	—37.0	—42.3	—34.7	—33.1	—31.9	—40.6	—35.4
Correction,	0.0	+ 5.3	— 2.3	— 3.9	- - - - -	+ 3.6	— 1.6

The small correction of the metallic thermometer at this extremely low temperature is a satisfactory proof that the low temperatures are correctly ascertained.

3. Other intermediate comparisons by A. Sonntag.

1860.	3	1	4	9	A	1063
October 6th A. M.	21°.3	20°.9	21°.2	21°.9	—4°.8	
" 6th P. M.	23.0	22.3	22.8	23.2	—4.3	
" 9th P. M.	22.6	22.1	22.4	23.0	—4.3	
Mean	22.3	21.8	22.1	22.7	—4.5	
Correction . . .	0.0	+0.5	+0.2	—0.4	+0.1	
October 10th noon,	11.6	10.5	11.3	12.3	— 9	
" 11th A. M.	6.0	4.7	6.0	7.0	—11.4	
" 11th P. M.	12.0	10.8	11.8	12.8	— 8.8	
" 11th P. M.	12.4	11.2	12.1	13.1	— 8.7	
" 12th A. M.	8.7	7.7	8.9	9.7	—10.4	
Mean	10.1	9.0	10.0	11.0	— 9.7	
Correction . . .	0.0	+1.1	+0.1	—0.9	0.0	
. . . .	—10.1	—12.5	—8.8	—7.7	—18.1	—7.8
Correction . . .	0.0	+2.4	—1.3	—2.4	— 0.6	—2.3

4. Additional comparisons of thermometers Nos. 4 and 6 with the standard; these comparisons being very numerous, the results only are given here.

Date.	Temperature by No. 4.	Correction to No. 4.	Number of observations.
1860. November 29	21°	+0°.0	1
" 26	between 12° and 13°	+0.5	2
1860. December 18—March 28 . .	" 2 and —10	—1.4	19
1861. February 4—April 3 . .	" —12 and —19	—2.5	15
" January 21—April 2 . .	" —21 and —28	—3.2	20
" January 23—March 26 . .	" —30 and —38	—3.4	6

Date.	Temperature by No. 6.	Correction to No. 6.	Number of observations.
1860 September 12	31°.3	+0°.7	4
" November 27—November 29 .	between 11° and 14°	+10.7	6
" November 25—November 30 .	" 10 and 0	+10.4	13
" November 12—November 26 .	" — 2 and —10	+11.3	19
" November 13—November 26 .	" —10 and —20	+11.4	20
" November 19—November 21 .	" —20 and —29	+11.6	7

The following corrections were adopted for No. 4:—

Temperature by No. 4.	Correction.
+32°	+0°.2
+22	+0.2
+11	+0.2
— 5	—1.4
—16	—2.5
—25	—3.2
—33	—3.4

A number of simultaneous readings of thermometers Nos. 3, 1, 9, A. 1663, also of a few others, were taken daily between November 12, 1860, and July 12, 1861, at the hours 8 A. M., 2 and 10 P. M. Of these readings such use will be made as circumstances seem to require. There are occasionally omissions in this record. Between November 26, 1860, and March 4, 1861, hourly readings of the same thermometers were taken on fifteen days (at intervals of one week)

Comparison of thermometers No. 3 and No. 13.

These thermometers were read together frequently between April 7, 1861, and July 6, 1861; the following corrections to No. 13 were deduced from these comparisons:—

Temperature by No. 13.	Correction.	Number of observations.
—22°	+1.1	7
—10	—0.9	17
+ 1	—0.2	25
+17	+1.6	25
+25	+1.8	54
+35	+1.2	74
+45	—1.2	27
+53	—1.9	3

These comparisons being made in the air, are yet sufficiently numerous to give a reliable correction.

Most of the meteorological instruments were kept in a large box on shore near the astronomical and magnetic observatory, in the rear of the harbor.

The record of the temperature of the air comprises daily bi-hourly observations (with occasional omissions) between September 1, 1860, and July 31, 1861. Thermometer No. 7 was used between September 1 and November 7, on which date No. 6 was hung up, No. 7 having been carried away. November 12th, thermometer No. 6 was taken to the meteorological box on shore, and No. 4 substituted, hung on a pole erected on the floe ice near the schooner. On April 5th, No. 13 was substituted for No. 4. On March 16th, the thermometers were changed in position at the box on shore, and on May 23d they were returned on board.

Temperature of the air, in shade, observed near and at Port Foulke, Smith Strait, September, 1860.

Day of the month	2h	4	6	8	10	Noon.	2	4	6	8	10	12h	Mean of 12 values by No. 7
1	- - -	19°.5	20°	21°	22°	22°	22°	22°.5	24°.5	26°	25°	- - -	22°.4
2	- - -	- - -	- - -	22	22.5	20	20	- - -	- - -	- - -	- - -	- - -	21.1
3	- - -	- - -	- - -	23	23	24	24	24	24	22	22	- - -	22.9
4	- - -	- - -	- - -	24.5	24	21.5	18	17	16.5	16.5	17	17°	20.2
5	- - -	- - -	- - -	21	21.5	22.5	- - -	- - -	- - -	29	29	- - -	23.8
6	- - -	- - -	- - -	29	30	29	28	26	28	26	25	24.5	27.7
7	27°	- - -	- - -	27	27	26	24	23	23	22.5	22.5	- - -	24.9
8	- - -	- - -	- - -	23	24	24	24	24	24.5	24	22	- - -	23.4
9	- - -	- - -	- - -	28	28	27	26	25.5	23	22.5	21.5	21	24.9
10	- - -	- - -	- - -	24	24	26	28	26	25	28	28.5	- - -	25.4
11	- - -	- - -	- - -	27.5	29	31	31	31	30	30.5	32	29	29.5
12	33.5	30	- - -	26	24.5	24	24	24.4	24.2	24	24.5	23	25.8
13	24	25	25	25	24.8	27	26	25	24.2	24	23	22	24.6
14	20	22	22	- - -	20	24	24	- - -	24.8	25.5	26	22.7	23.0
15	23	22.5	20	20	22	- - -	27	27.5	27.3	26.7	26.5	26	24.4
16	30	28.5	30	32	32	- - -	31	31	30.5	27.5	26	24.8	29.6
17	25	25	23	23	22.3	- - -	23.5	23.5	22	- - -	21	18.8	23.6
18	17.5	18	19	21	21	22.5	23	22.5	21	20.5	19	17.5	20.2
19	14.5	15.5	17	18.5	19	21	21.5	20.5	15.7	15.8	15	15	17.4
20	14.5	17	17.5	18	19.5	20	21	20.5	18.2	19.5	19.5	19.5	18.7
21	19	20	- - -	23.5	21.5	20.5	22	23.5	25.7	- - -	- - -	24.5	22.7
22	26	27	- - -	26.3	26	27	30	30	24	21.3	21	19.3	25.4
23	16.5	15.5	- - -	15.3	14.5	- - -	17	19	16.5	16	17	17	16.3
24	17	16	- - -	17	17.7	19.5	21	20.5	21.5	21	21	- - -	19.0
25	17.6	19	21	20	- - -	- - -	20	20.5	- - -	18	18.5	16.5	19.2
26	- - -	19	19.5	17	16	18	18.3	17	- - -	16	15.5	14	17.0
27	- - -	- - -	14	15	- - -	- - -	- - -	19.5	19.5	- - -	- - -	21.5	17.5
28	23	22.5	22.5	22	- - -	- - -	17	- - -	16.8	17	13	10.3	18.4
29	7.5	9	8.5	7.3	10	9	10	9	8	8.5	9	8.5	8.7
30	- - -	10	9.5	10	9.5	10	10.5	11	11	11.8	11	11.3	10.4

Thermometer No. 7 hung on a pole on the floe ice near the vessel. This thermometer is used till Nov. 7th.

October, 1860.

Day of the month.	2h	4	6	8	10	Noon.	2	4	6	8	10	12h	Mean of 12 values by No. 7
1	14°.5	- - -	14°.5	14°.5	14°.5	13°.5	13°.5	14°	16°	16°	16°.2	20°	+15°.1
2	17	19.5	24	23.8	24.5	24.5	22.5	23	20	17	- - -	13.6	+20.4
3	- - -	13	14.5	15	- - -	- - -	25	26	25	25	23.5	24.5	+20.4
4	25	- - -	24.5	23.5	24.5	24.5	24.5	25	24.5	25	24	24.5	+24.5
5	23.5	24	- - -	25	24.5	24.5	24	20.5	20	18.5	17.5	17.8	+22.0
6	17	16.5	19	20	20.5	22	23.5	23	23	23	23	24	+21.2
7	24	- - -	14.5	23.2	23.5	24	25	25	25.3	25.5	27	- - -	+23.7
8	- - -	26	27	27	27	27.5	28	28	27.5	27.5	27	26.5	+27.1
9	27.5	26.5	- - -	27.5	26.5	27.5	27	26	25	23	19	20	+25.2
10	21	16	- - -	16	15	11.6	14.5	14.5	15	15	12	13.5	+15.0
11	10.5	10	- - -	6	11.5	12	12.4	17	11	12	10	11	+10.9
12	7	7	9	9	8.7	13	10.5	14	15	15.5	15	10	+11.1
13	10.5	9.5	10	8.5	9.3	8.8	- - -	4	3.5	−0.5	−1	−3	+5.5
14	−2	−3	−2	−0.5	−1	−1	−2	−1.5	−2	−2	−4	−8	−2.4
15	−7	−6	−6.5	−5	−4	−4	−5	−3	−3	−2.5	−3	−5	−4.5
16	0	- - -	−3	+2.5	+2.5	+2	+2	+2	+2	+1.5	+1	0	+0.9
17	+1.5	+2	+2	+2	- - -	- - -	- - -	- - -	+2	+2	−4	+5	+1.7
18	+3	+2	−1	+0.5	−3	−1	+2	+2	+2	+2	−1	−5	+0.2
19	−5	−6	−5.5	−4	−3.5	−3.5	−5	−5.5	−6	−6	−6	−6	−5.2
20	−6.5	+6	+5.5	+5.5	- - -	- - -	+5.5	+5	+4	+3	+3	+3	+3.8
21	−3.5	−2.5	−3	−3	−3.5	−4	−3	−3	−3	- - -	- - -	+2	−2.3
22	+3	+4	+4	+6	+6	+6.3	+5	+3	+3	+2	+1.5	−3	+3.4
23	−2.5	−1	- - -	−3	- - -	- - -	−3	−2.5	−2	+1	0	−3	−2.0
24	−5.5	−6	−6.5	−7	−2.5	−3	−3	−5	−7	−7	−7.5	−8	−5.7
25	−10	−9	- - -	−13	−7	−5	−7	−6	−6.5	−6.5	−7	−7.5	−8.0
26	−10	−10	−11	−10	- - -	- - -	- - -	−7	−7	−7.5	−8	−8.5	−8.7
27	- - -	−11	−10.5	−6	- - -	- - -	−3.5	−3.5	−4	−5.5	−5	−4	−6.0
28	−5.5	−8.5	−11	−12	−9.5	−3	+3	+2	+1.5	+1	0	+1	−4.0
29	−2	−1	−1.5	−7	−4	0	+1.5	+1	0	0	0	0	−1.1
30	+1	+2.5	- - -	+3	+3	+3	+3	+2	+2	+1.5	+1	0	+2.1
31	+1	+2	+0.5	+1.5	0	0	−0.5	−3	−0.5	+1.5	+1.5	0	+0.3

Temperature of the air, in shade, observed at Port Foulke, Smith Strait.

November, 1860.

	Day of the month	2h	4	6	8	10	Noon.	2	4	6	8	10	12h	Mean of 12 values by No. 4
Daily mean by No. 7	1	−1°	0°	0°	−0°.5	0°	+1°	+1°	+0°.5	0	−0.5	−1.5	−1	−0.3
	2	−3	−4.5	−4.5	−1.5	−2	−3.5	−4.5	−2	+1.5	+1	+0.5	−1.5	−2.0
	3	−2	−2.5	−4	−2.5	−4	−6.5	−6	−6	−6	−5	−3	−3.5	−4.3
	4	−4	−4.5	−3.5	−2.5	−1	−1	−1	−1	−1	−1	−1	0	−1.8
	5	−1.5	−1.5	−2	−5	−6.5	−7	−7	−7.5	−7.5	−8	−10	−12	−6.3
	6	−11	−8	−11	−10	−10	−8	−9	−9	−8	−9	−10	−10	−9.4
Daily mean by No. 6	7	−11	−12	−8	−9.5	−10.5	- - - -	−16[1]	−13[1]	−10[1]	−6[1]	−7[1]	−5[1]	14.8
	8	−3[1]	−3.5[1]	−3[1]	−1.5[1]	0[1]	+4[1]	+2[1]	+2[1]	+2[1]	−1[1]	+4[1]	+7[1]	+0.6
	9	+5	+5[1]	+4.5[1]	+2[1]	+11[2]	−1.5[1]	−1.5[1]	−1[1]	+4[1]	+3[1]	+2	+1[1]	+1.0
	10	+2[1]	+2.5[1]	+2	−4[1]	−5[1]	−6[1]	−6[1]	−6.5	−7.5[1]	−8[1]	[illegible]	−9.5[1]	4.0
	11	−12[1]	−12[1]	−9.5[1]	−6.5[1]	−5[1]	−4.5[1]	−5.5[1]	−5.5	−5.5[1]	−4.5[1]	−3[1]	−4.2[1]	[illegible]
	12	−5.5[1]	−5[1]	−5[1]	−5[1]	−3.5[1]	−3	- - - -	+5[1]	+5	+4.5	+4.5	+4.5	5.6
Daily mean by No. 4.	13	+4.5	+5	+5	+4.5	+4	+3	+3.5	+4	+5.5	+7	+8.5	[illegible]	+5.2
	14	+8	+8.5	+11	+9	+7	+6	+6	+5	+5	+4.5	+4	+2	+6.3
	15	+5	+3	+4.5	+4	+4	+3.5	+1.5	−1	−2.5	−3	−3.5	[illegible]	+0.5
	16	- - - -	- - - -	- - - -	0	0	0	0	0	0	−1	1.5	−3.5	1.6
	17	−4	−1	+0.5	0	0	0	0	−0.5	−1	−3	3.5	5	1.5
	18	−7.5	- - - -	- - - -	−1	−1	−1	−4	−3.5	−3	−2.5	−2.5	−5	−3.3
	19	−11	−12	−11	−10.5	−10	−7.5	−7.5	−8	−9	−9	−10	−10	−9.6
	20	−11	−11	−12	−15	−15	−17	−17	−15	−13	−12	−12	11.5	−13.5
	21	−10	−10	−11	−13	−11.5	−10	−10	−5	−6	−4	−1	0	7.6
	22	+1	−1	+2.5	+3	+3.5	+1.5	+1	+3	+2	- - -	- - -	1.5	+0.8
	23	+3	+4	+5	+4	+5	+5	+5	+5	+5	+3	+1	0	+3.8
	24	−1	−2	+2	−1	+3	+6	+3	+2.5	+2	+2	+2	+2.5	+1.8
	25	+2.5	+3	+3	+5	+9	+11	+13	+18	+13	+13	+13	+13	+9.7
	26	+11	+4[4]	+7[4]	+7.5[4]	+13[4]	+10	+10	+13	+11	+8	+12	+13	+10.0
	27	+9	+11	+10	+10	+13	+17	+25	+22	+21.5	+21.5	+19	+18	[illegible]
	28	+20	+21	+27	+32	+25	+27	+28	+25	+25	+25	+26	+24	+25.4
	29	+24	+23	+21.5	+21	+17	+15	+17	+18	+21	+22	+19	- - - -	+19.8
	30	+19	+17	+17	+16	+15	+15.5	+15	+15	+15	+15	+15	+10	+15.2

[1] Thermometer No. 6.
[2] Thermometer No. 3.
[3] Thermometer No. 4; used till April 5, 1861.
[4] Recorded negative; supposed by mistake.

December, 1860.

Day of the month.	2h	4	6	8	10	Noon	2	4	6	8	10	12	Mean of 12 values by No. 4
1	+9°.5	- - - -	+12°	+12°.5	+7°	+8°	+9°	+9°.5	+10	+9	+10	+10	+9.8
2	+9	+9°	+9	- - - -	+7	+3.5	−2	−2	−2	0	−1	+1	+3.3
3	0	−5	−11	−13	−11	−9	−13	−14	−14	−12	−12	−15	−10.7
4	−17	−21	−19	−21.5	−19.5	−22	−23	−4	−4	−3.5	- - - -	- - - -	−15.5
5	−4	−2	- - - -	−3	−3	−3	−4	−4	−6	−4	−3.5	−3	−3.5
6	−4	−5	−7.5	−9	−10	−12	−13	−13	−10	−10	−12	−13.5	−9.9
7	−15	−15.5	−16	−16	−13.5	−12	−18	−18	−18	−18	−18	- - - -	−16.3
8	−17	−18	−17	- - - -	−18	−18	−15	−15	−14	−19	−19	−19	−17.2
9	−19	−20.5	−19	−17.5	−19	−19	−17.5	−19.5	−20	−20	−24	−20	−19.6
10	−22.5	−23	−27	−26	−20	−20	−19	−19	−27	−19	−26	−19	−22.3
11	−19	−20	−22	−21	−20	−19	−8	−8	−9	−10	−11	−11.5	−14.9
12	−11	- - - -	−10	−14	−20	−16	−19	−18	−19	−15	−16.5	−19	−15.7
13	−18	−17	−16	−17	−8	−8.5	−10	−10	−11	−11.5	−12	−9	−12.3
14	−12	−13.5	−13	−16.5	−16.5	−17	−18	−18.5	−22	−21	−22	−17	−17.3
15	−16.5	−16	−8	−7	−7	−7	−7	−8	−8	−9	−9	11	−9.5
16	−12.5	−12	−13	−8	−8	−7.5	−7	−8	−10	−13	−14	- - - -	−9.9
17	+2	−7	−5	−4	−4	−4	−3	−3	−3	−2	−1.5	- - - -	−2.9
18	+1.5	−1	−1	−2	−0.5	−1	0	−4	−6	−2	+1	−1	−1.3
19	−3	−3	−2.5	−2	−2	−2	−3	−3	−4.5	−6	- - - -	−4	−3.3
20	−3	−5	−5.5	−6	−7	−7	−7	−8	−7.5	−8.5	−10	−11	−7.1
21	- - - -	−15	−15.5	−18	−14.5	−14	−10	−10	−14	−19	−19	−20	−15.2
22	−20	−20	−20.5	−21	−21	−19	−20	−20	−19.5	−17.5	−10	- - - -	−17.9
23	−3	−2	−1	+1	+1	+1	+1	+2	- - - -	- - - -	+10	+9	+2.6
24	+12	+9	- - - -	+2	+2	+3	+3	+3	−2	−3	−4	−4.5	+2.2
25	−5	−9	−7	−7	−7	−9.5	−10	−10	−12	−13.5	−14	11	−9.2
26	−11	−13	- - - -	−13	−12.5	−12	−12.5	−12.5	−12.5	−13	- - - -	−15	−12.8
27	−15.5	−16	- - - -	−18	−18	−18	−18.5	−17	−18	−20	−20	−18	−17.8
28	−18	- - - -	- - - -	−19	−14	−11	−7	−7.5	−8	−8.5	−16	−9	12.9
29	−11	−11.5	- - - -	−13.5	−14	−11	−9.5	−10	−11	−14	−17	−21	−13.0
30	−20	−24	- - - -	−23	−20	−24	−22	−20	−20	−20	−20	−15	21.0
31	−20	−18	−21	−21	−22.5	−22.5	−24	−11	−17	−17	−19	−14.5	−19.0

Temperature of the air, in shade, observed at Port Foulke, Smith Strait.

January, 1861.

Day of the month.	2h	4	6	8	10	Noon.	2	4	6	8	10	12h	Mean of 12 values by No. 4
1	−19°	−20°	−19°	−20°	−21°	−23°	−20°	−23°	−23°.5	−24°	- - - -	−25°	−21°.8
2	−25	−27	−23	- - - -	−26	−27	−25	−25	−25	−25.5	−20°	−20	−24.4
3	−21.5	−19	−25	−25	−27	−30	−30	−30	−31	−31	−31	−32	−27.7
4	−30	−26	−28	−29	−29	−28.5	−29.5	−28	−22	−15	−15	−16	−24.7
5	−16	−17	−18	−21	−20	−20.5	−26	−30	−28	−26.5	−29	−30	−23.5
6	−31	−33	−34	−32.5	−32	−32.5	−32.5	−17	−16	−15.5	−22	−20	−26.5
7	−22	−24	−25.5	−21	−17	−16	−18.5	−17	−14.5	−16	−25	−27	−20.3
8	−25	−18	−18	−11.5	−11	−14	−14	−14.5	−15	−19	−21	−18	−16.6
9	−20	−18	−16	−17.5	−13	−11	−17	−17.5	−18	−17	−16	−21	−16.8
10	−21.5	−23	−24	−23	−20.5	−19	- - - -	−19	−17.5	−17	−16	−10	−19.1
11	−9	−8	- - - -	−10	−10	−10	−7	−11	−11.5	−13	−14	−13	−10.5
12	−13	−15	−16	−13	−14	−13.5	−13	−15	−18	−19	−17	−9	−14.6
13	−10	−12.5	−14	−17	−17	−19	−19	−18.5	−19	−16	−13	−15	−15.8
14	−17	−12	−12	−4	−5	−8.5	−7	−7	−6.5	−7.5	−4	−7	−8.1
15	−11	−13	−17	−16	−14	−15	−22	−21	−21	−20.5	−20	−20	−17.5
16	−21	−22	−22	−29	−28	−28	−28	−29	−29	−25	−23.5	−18	−25.2
17	−19	−22	- - - -	−18	−18	−18	−20	−23	−25	−24	−27	−28	−21.8
18	−30	−30	- - - -	−28	−30	−30	−26	−25	−25	−20	−14	−15	−25.2
19	−17	- - - -	−14	−18	−20	−21	−21.5	−22.5	−24	−26.5	−28	−28	−21.3
20	−28.5	−29	−32	−29.5	−32	−32	−32	−32.5	−30	−30	−27	−28	−30.2
21	−29	−30	−32	−27.5	−24	−25	−25	−26	−26.5	−25	−26	−26.5	−26.9
22	−29	−26	−26	−25	−25	−28	−27.5	−27.5	−28	−30.5	−32	−33	−28.1
23	−34	−34	−36	−34	−38	−38.5	−38	−38.5	−39	−35	−43 ?	−37	−37.1
24	−32	−30	−28	−24	−22	−22	−22	−21	−26	−28	−33	−37	−27.1
25	−39	−40	−42	−39	−35.5	−25	−26	−24	−23.5	−25	−25	−27	−30.9
26	−26.5	−25	−27	−24	−26	−25	−25	−30	−28	−27.5	−27	−26	−26.4
27	−27	−25	−24	−22.5	−17	−17.5	−18	−18	−19	−20	−17	−19	−20.3
28	−19	−19.5	−18	−18	−20	−19.5	−19	−25	−23	−25	−28	−29	−21.9
29	−24.5	−21	−21	−22	−24	−25	−22	−25	−26.5	−28	−26	−25	−24.2
30	−26	−26	−27	−26	−25.5	−25	−27	−25	−27	−27	−28.5	−29	−26.6
31	−35	−36	−36	−33	−34	−32	−31.5	−33	−30	−30	−27	−28	−32.2

On the 23d, 10 A. M., mercury in a glass vial froze on the ice in front of the ship. Thermometer No. 9 remained stationary at −36°.8 at the observatory. Mercury thawed at 2 A. M. January 24. January 25, Thermometer No. 9, mercury froze at −36°.5.

February, 1861.

Day of the month.	2h	4	6	8	10	Noon.	2	4	6	8	10	12h	Mean of 12 values by No. 4
1	−30°	−29°	−26°	−27°	−22°.5	−15°	−9°	−10°	−12°	−15°	−17°	−14°	−18°.9
2	−13	−8	−9	−12	−12	−12	−17	−19	−19	−19.5	−20	−24	−15.4
3	−26	−21	−20	−19	−21	−22.5	−24.5	−30.5	−35	−35	−35	−29	−26.5
4	−32	- - - -	−26	−19	−18	−18	−18	−18	−18	−18	−16	−19	−20.8
5	−16	−25	−20	−24	−20	−20	−19	−19	−20	−17	−19	−24	−20.2
6	- - - -	−26	−26	−24	−18	−17.5	−19	−18	−17.5	−15	−16	−26	−20.7
7	−27	−26	−27	−29	−27	−27	−21	−27	−28	−29.5	−28	−30	−27.2
8	−28	−28	−24	−15.5	−24	−24	−24	−24.5	−25	−24	−23.5	−19	−23.6
9	−18	- - - -	−16	−21.5	−22	−20	−18	−20	−21	−22	−20	−24	−20.0
10	−25	−25	−21	−22	−22	−23.5	−26	−25.5	−25	−25.5	−26	−25	−24.3
11	−26	−20	−19	−17	−17	−17	−17	−19	−17	−19	−18	−18	−18.7
12	−17	−16.5	−18	−17	−17	−18	−20	−20.5	−21	−21	−20	−28	−19.5
13	−26	−29	−33	−32	−31	−31	−35	−32	−32	−27	−25	−28	−30.1
14	−28	−29.5	−31	−25	−30	−29	−29	−27.5	−27	−27	−27	−29	−28.3
15	−31	−32.5	−34	−30	−31.5	−32.5	−31.5	- - - -	- - - -	- - - -	−32	−32	−31.9
16	−34	−37	−38	−31	−31	−30.5	−29	−28.5	−28	−29	−30	−26	−31.0
17	−29	−33	−35	−31	−31	−30	−18	−25	−25	−26	−28	−23.5	−27.9
18	−23	−24	- - - -	−25	−26	−26	−25	−26	−20.5	−23	−24	−21	−24.0
19	−23	−27	−26	−27	−30	- - - -	−27	−31	−32	−30.5	−29	−30	−28.4
20	−30	- - - -	−14	−10	−11.5	−13	−11	- - - -	−13	−15	−16	−20	−15.6
21	−22	−25 ?	−9	−8	−8	−10	−10	−11	−11.5	−13	−10	−14	−12.6
22	- - - -	−19	−19	−17	−16	−16	−16.5	−15	−16	−16	−21	−22	−17.5
23	−20	−20	−25	−25	−20	−16	−10	−9	−11.5	−12.5	−15	- - - -	−16.7
24	−16	−17	−16	−17	−17.5	−18	−17	−19	−19	−19	−17	−22	−17.9
25	−21	- - - -	−18	−17	−14	−16	−16	−18	−18	−18	−19	−19	−17.8
26	−21	−24 ?	−25 ?	−14	−16.5	−17	−20	−18	−20	−15	−18	−19	−19.3
27	- - - -	−20	−18	−20	−21	−23	−19	−21	−21	−21.5	−22	−21	−20.6
28	−24	−25	−25	−19	−20	−19.5	−16.5	−18	−19	−20	−14	- - - -	−19.6

February 18, sun seen above the horizon; February 25, 2 P. M., sun shone on deck; and at 2½ P. M., on observatory.

Temperature of the air, in shade, observed at Port Foulke, Smith Strait

March, 1861.

Day of the month	2	4	6	8	10	Noon	2	4	6	8	10	12	Mean
1	−16	−16	−19	−23	−24	−23	−21	−22.5	−20	−18	−14	[illegible]	−18.7
2	−9.5	−9.5	−9	−9	−9.5	−9	−9	−13	−14	−14	−13	−15	[illegible]
3	−14	−12	−16	−15	−14	−12	−11	−17	−14	−14.5	−14	−17	−14.2
4	−22	----	−23	−19	−19	−19	−17.5	−20	−22	−24	−23	[illegible]	[illegible]
5	−23	−27	−29	−29	−27.5	−29	−30	[illegible]	−32	----	[illegible]	[illegible]	[illegible]
6	−35	−35	−35	−32	----	−28	−22.5	[illegible]	[illegible]	−27.5	[illegible]	----	[illegible]
7	−25	−23	−22	−24	−23	−23	−18	−19	−21	−22	−22	[illegible]	[illegible]
8	−23	−27	−19	−13	−11	−14.5	−10	−13	−12	−11.5	−11	−11	[illegible]
9	−14	−14	----	−17	−15	−12	−4	−7	−9	−10	−12	−15	[illegible]
10	−11	----	−15	−17	−16	−15	−12	−12	−10	−10	−10	−11	−12.7
11	----	−14	−10	−12	−13	−13.5	−10	−11.5	−14	−15	−15	[illegible]	[illegible]
12	−16	−16	−18	−15	15	−14	−13	−13	−14	−15.5	−16	−20	[illegible]
13	−20	−23	−25	−24.5	−18	−18	−12	−17	−27	−28	−31	−31	[illegible]
14	−31.5	−34	−30	−20	−25	−22	−20	−21	−25	−25	−25	−28	−25.5
15	−31	−32	----	−27	−28	−26.5	−16	−20	−24	−27	[illegible]	[illegible]	[illegible]
16	−35	−38	−35	−32	−31	−29	----	----	−22	−20	−18	−28	−28.2
17	−20	−20	−24	−25	−27.5	----	−21[1]	−23[1]	−28.5	−30	−31	−33.5	−25.0
18	−34	−34	−31	−16	−17.5	−17	−15[1]	−15.5[1]	----	−23	−27.5	−17	−21.6
19	−18	−19	−19	−22	−20	−18.5	−17.5[1]	−19[1]	−20	−14	−15	−20	−18.1
20	−21	−27	−14	−13	−15	−15	−14[1]	----	−21.5	−25	−25	−27	[illegible]
21	−29	−28	----	−28	−25	−22	−21	−24[1]	−21	----	−25	−29	−25.0
22	−31	----	−33	−24.5	−25	−26	−22[1]	−21.8[1]	−28	−31	−31	−32	−27.6
23	----	−30	−30	−30.5	−28	−28[1]	−21[1]	−20[1]	−27	−30.5	−33	----	−27.8
24	−35	−37	−38.5	−34	−32	−30[1]	−26[1]	−27[1]	−28	−31.5	−32	−31	−31.0
25	−28	−22	−20	−19.5	−14	−11	−18[1]	−19[1]	----	−22	−25	−29	−20.1
26	−30	−32	−32	−30	−30	−28[1]	−22[1]	−16[1]	−13	−13	−17	−21	−22.9
27	−24	−23	----	−12	−11	−12	−10	−14	−9	−9	−14	−10	−13.8
28	−9	----	−5	−2	−5	−5	−5.5	−2	−4.5	−5	−7	−8	−5.4
29	----	−11	−13	−16	−12	−10	−6	−8.8	−8	−7.5	−8.5	----	−10.5
30	−11	−12	−12	−9	−8	----	−7[1]	−7	−6	−7.5	−9.5	−16	−9.1
31	−19	−22	−21	−17.5	−11	−10[1]	[illegible]	[illegible]	−6	−11	−15	−17	−12.7

March 16, 2 P. M., moved the thermometers from the front to the rear of the meteorological box on [illegible], to protect them from the sun.

[1] Readings by thermometer No. 3.

April, 1861.

Means referred to No. 13.

Day of the month	2[2]	4	6	8	10	Noon	2	4	6	8	10	12	Mean
1	−15[2]	−18[2]	−22[2]	−19[2]	−19.5	−15[2]	−10.5	----	−11	−15	−15	−18	[illegible]
2	−16	−17	----	−17.5	−16	−15.5	−15.5	−16.5	−17	----	−16	−18	[illegible]
3	−17	----	−21	−19	−23	−22.5	−18	−17	−20.5	−18.5	−21	−22	[illegible]
4	−22	−23	−21	----	−17	----	−12.8[1]	----	----	−19	−22	−22	−22.0
5	−20	−17.5	----	−11	−13	−12	−13[2]	−12	−12	−13	−15	−16	[illegible]
6	−15.5	−15	−13	−10	−10	−12.5	−12.5	−14	−17.5	−15.5	−19	−23	−14.6
7	−23	−25	----	−20	−21	−21.5	−20	−24	−24	−23.5	−23	−23	−22.5
8	−25	−27.5	−25	−24	−22	−21	−20	−21	−22	----	−23.5	−25	−23.2
9	−24	−24	----	−20	−20	−18.5	−17.5	−18.5	−20	−19.5	−19	−19	−20.2
10	−20	−19	----	−15	−15	−16	----	−18.5	−21.5	----	−27	−27	[illegible]
11	−26.5	−27	----	−26	−26	−24	−21.5	----	−19.5	−18	−17	−16	[illegible]
12	−14	−14	----	−11.5	−7	−6	−5	−8	−10	−11	−15	−17	[illegible]
13	−15	−15.5	----	−11.5	−7	−10	−10	−11	−11	−11	−12	−12	−11.6
14	−13	−13	−13	−13	−13	−11	−11	−11	−11.5	−12	−15	−15	−12.6
15	−13	−11	−11	−11	−11	−10	−11	−10	−13	−17.5	−18	−18	−12.7
16	−16	−16	----	−10	−8	−9	−7	−8	−8	−8	−11	−11	[illegible]
17	−12	−12	----	−10	−8	−3	−0.5	−0.5	−1	+1	2	−5.5	[illegible]
18	−3	−4	----	0	+1	+1	+1	−2	−4	----	−8.5	−10	[illegible]
19	−10	−10	----	+1	+2	+2	+2	+3.5	+5	+5	+1	−1	[illegible]
20	−7	−8	----	+1	+2	+4	+4	+3.5	+4	+5	+3	+3	+0.9
21	+2.5	+2	+2	+1.5	0	−1.5	−3.5	−5	−6.5	−8	−8.5	−9	[illegible]
22	−8.5	−8	----	−2.5	−2.5	−2.5	−3	−4	−4	−4	−8	−8	[illegible]
23	−8.5	−9	−6.5	−2.5	−2.5	−2.5	−4	−4	−4	−4	−4	−4	[illegible]
24	−5.5	−5.5	−3	−2	0	+1	+1	0	−0.5	−4	−4	−5.5	[illegible]
25	−6	−6.5	−7	−8.5	−10	−9.5	−9	−9.5	−10	−10	−10.5	−10.5	[illegible]
26	−14	−16	−13	−9	−6.5	0	−1	−1	−3	−5.5	−9.5	−11	[illegible]
27	−8	−7	−6	−6	−6	−6.5	−6	−6	−6	−6.5	−7	−7	[illegible]
28	−9	−8	----	−6	−4.5	−3	−3.5	−5	−6.5	−8	−5.5	−8	[illegible]
29	−7.5	−7.5	----	−4	−3.5	−1.5	−0.5	0	+1	+1.5	+2	+2.5	[illegible]
30	0	−1	+1.5	+2.5	+4	+6	+8	+6	+4.5	+4.5	1.5	+2	[illegible]

[1] Readings by thermometer No. 3.

[2] All the following readings by No. 13: thermometer No. 4 was taken in and No. 13 hung on the port-side forward, facing east, and in the shade.

Temperature of the air, in shade, observed at Port Foulke, Smith Strait.

May, 1861.

Day of the month.	2h	4	6	8	10	Noon.	2	4	6	8	10	12h	Mean of 12 values by No. 1.
1	2°	2°.5	- - -	4°	4°.5	5°	6°	5°	4°.5	2°	0°.5	0°	+3°.3
2	1	1.5	1.5	2	2	2.5	—1	—1	6	9	7	4	2.9
3	5.5	7.5	- - -	12	12	10	9.5	8.5	8	7.5	6	3.5	8.3
4	5.5	7	- - -	10.5	13	13	15	15.5	16	15.5	15	14	12.4
5	13	13	12.5	12	14	17	17	11	12	12.5	14	13	13.4
6	12	19	23	24	24	24	24	25.5	25	22	17	19	21.5
7	15	20	- - -	19[1]	25	26	26	24	20.5	19	19.5	18	20.8
8	20	20	21	25.5	28	30	30	31.5	29	27	27	26	26.2
9	26	26	27	34.5	33	31	29	28	27.5	24	- - -	22	27.6
10	25	22	- - -	27	31	33.5	35	38	36	34	30.5	31	30.6
11	24	25	- - -	31	30	31	30	29.5	29.5	30	27.5	27	28.5
12	25	32	34	- - -	32	32	35	38	40	31	27	27	32.2
13	28	30	- - -	38	38.5	40	- - -	- - -	36	34	- - -	29	34.6
14	27	28	- - -	34	35	35	37	36.5	39	30.5	27	25.5	32.1
15	26	32	34	33	37	33	34	30	30	31	32	29	31.8
16	29	29	30	33	35	34.5	34.5	33.5	32	27	27	22	30.5
17	25	23	21	27	29	31	28.5	29.5	24	- - -	24	20	25.5
18	19	20	21	19	17.5	19	19.5	19	20	18	16	17	18.8
19	13	14	12	20	20	16	17	17	16	15	12.5	14	15.5
20	13	16	10	14.5	14	17	19	17	16	17	16	15	15.4
21	15	16	17	- - -	20	22	23	21.5	23	19.5	18.5	18	19.3
22	16	20	- - -	28	23.5	23.5	23	21	20	19.5	17	10	20.5
23	13	16	- - -	22	22	22	22	21	20	19	17.5	18	19.3
24	19	24	21	21.5	23	23	23	23	23	23	23.5	22	22.4
25	21	20	22	24	28	29	23	25	22.5	21	20	19	23.1
26	19	27	29	30	30	29.5	29	37	36	31	26.5	25	29.1
27	26	27	30	32.5	36	39	31.5	30	31	30.5	27.5	27	30.7
28	22	22	28	37	30.5	28.5	28	32	31	29.5	26.5	30	28.8
29	24	29	- - -	26	28	30	29	28	27.5	25	24	23	26.8
30	23	23	25	23.5	24	24	24	23.5	23.5	20.5	19	18	22.6
31	16.5	16.5	17	18	18	21.5	20.5	19.5	19.5	19.5	19	18	18.6

May 9th, the thermometers on shore were placed in a large box to protect them from the rays of the sun. May 23d, thermometers brought on board.

[1] Recorded by thermometer No. 3.

June, 1861.

Day of the month.	2h	4	6	8	10	Noon.	2	4	6	8	10	12h	Mean of 12 values by No. 1.
1	18°	17°	20°	19°.5	19°.5	20°	22°	21°	21°	20°	19°	18°	+19°.6
2	17	18	18	20	21	21	21.5	21.5	20.5	20	18	18	19.5
3	18	16	18	18.5	19.5	20	21	21.5	21.5	21	20	21	19.7
4	21	22	- - -	23	23	25.5	25	27	28	29	27.5	28	25.1
5	27	28	29	27.5	28	29	30	31.5	28	25	23	21	27.3
6	21	23	25	26	27.5	27	28	29	27	26	24	19	25.2
7	19	26	26	27	32	34	34	34	32	25	25	19.5	27.8
8	25	26	31	28	29.5	30	29	- - -	29	28	24	- - -	27.5
9	22	28	- - -	32	38	40	41	42.5	39	- - -	30.5	31	34.1
10	28	31	31	31	- - -	36	36	36	33	31	28.5	30	32.1
11	31.5	30	- - -	33	33	35.5	36	36	35.5	32.5	32	31	33.1
12	31	30.5	31	32	34	- - -	33	33	34	34	- - -	32	32.6
13	31	36	34	33	35	33	33	32	32	32	32	31	32.8
14	30	34	37	35	39	41	41	35	33	31	31	30	34.8
15	30	35	37	- - -	- - -	- - -	39	33	33	33	33	30	34.8
16	33	33.5	31	33[1]	33	33	33[1]	32	32	32	33[1]	33	32.3
17	33	32	31.5	32	34	35	36	34.5	35	34	34	35	33.8
18	32	- - -	33	36	36.5	34	34.5	35	34.5	34.5	33	35	34.2
19	34	35	34	35.5	35	34	35.5	34	33	32	33	33.5	34.0
20	33	34	35	35	35	40	40	40	39.5	- - -	35	32	36.3
21	32	35	34.5	39	43	44	49	49	43	43.5	35	- - -	40.0
22	32	- - -	41	42	43	43	- - -	43.5	46.5	45	42	42	41.6
23	43	40	41.5	39	40	44	47	46	42	43	38	38	41.8
24	37	37	39	39.5	40	40	43	43	43	39	- - -	37	39.6
25	37	39	39	39.5	37.5	39	39	39	39.5	40	40.5	39.5	39.0
26	39	39	38	38	38	39	39	36	37	38	39	38	38.2
27	37	38	38	38	38	39	39	37	36	34	34	33	36.8
28	33	33	34	36	36	36	38.5	39.5	40	39.5	38.5	35	36.6
29	35	34	35	37	38	36	36	36	37	39	35	35.5	36.1
30	34	35	35	37	36.5	35	38	37	37	36.5	37	35	36.1

[1] Recorded by No. 3.

Temperature of the air, in shade, observed at and near Port Foulke, Smith Strait.
July, 1861.

Day of the month.	2h	4	6	8	10	Noon	2	4	6	8	10	12	Means
1	36°	37°	- - -	40°	40°	41	41.5	38	38	37	40	37	[illegible]
2	35	35	35°	33	34	34	40	38	39	34	43	[illegible]	36.3
3	- - -	38	39	41	43	47	51.5	46.5	44	43.5	39.5		42.[illegible]
4	42	44	40	39	- - -	39.5	39	- - -	39.5	33.5	33	32	38.0
5	32	35	39	39	39	49	63	45	43.5	41	37	36	42.4
6	36	36	39	39	3.	42	48	56	47	43	38	36	41.6
7	35	39	- - -	43	50	48	48	49	47	48	44	44	44.7
8	42.5	41.5	37	40	39.5	40	40	40	40	38.5	39	38	39.7
9	38	42	- - -	44	47	- - -	47	46	47.5	40	42	41	[illegible]
10	40.5	41	43	43	44	45	41	43		- - -	36	36	41.2
11	36	31	- - -	39	38.5	58	42	39	40	42	45	43	39.0
12	48	40	- - -	54	56	56	55	61	- - -	44	- - -	- - -	46.5
13	36	36	- - -	34	34	34.5	37	47	49	44	38	35	38.3
14	34	37	40	43	44	37[1]	39	44	46.5	44	53	37	41.5
15	40	44	39	48	48	40	45	40	40	43	43	[illegible]	42.4
16	36.5	35.5	36	35	36	36	36.5	36	35	36	36	35.5	35.8
17	35	35	35.5	36	37	39	42	41.5	- - -	43	38	37	38.4
18	39	39	39.5	40	40	42	42	41	42	41	38	38.5	40.2
19	38	38	41	42	39	39	40	39	40	38	[illegible]	38	39.2
20	39	41	40.5	42	48	38	41	- - -	38	37	36	34	39.5
21	35	35	35	35	36	40	39	38.5	40	36	37	34	36.5
22	34	35	37	38	42	40	38	37	36	34	34	34	36.6
23	32	32	32	32.5	33	34	- - -	38.5	- - -	37.5	35	34	34.6
24	35	36.5	38	39	- - -	34	- - -	34	32.5	32.5	32.5	32	34.7
25	31	31	32	32	32.5	33	33	33	34	35.5	34	34.5	33.0
26	35	36	36	38	38	40.5	43	46	43	47	53	40	41.3
27	36.5	33.5	34.5	35	41	43	44.5	43	43.5	59	53.5	48.5	43.0
28	50	53.5	56	63	65	- - -	- - -	- - -	- - -	59	47	47	55.1
29	54	50	45	51	45	47	56	60	46	47	59	53	51.1
30	49	47	44	48.5	45	50	45	48	44.8	40	36	34	44.3
31	34	35	35	35	36	37	37	38.5	38	35	32.5	32.5	35.5

[1] Pulled out of Port Foulke. The original record after July 14, noon, is by "sea days," or astronomical reckoning, which is here changed to civil reckoning.

Notes to preceding Record.

[1]November, 1860. The five readings of the 7th, recorded by No. 7, and the five readings of the 12th, recorded by No. 4, as well as the reading by No. 3, on the 9th, were referred to No. 6 by application of the corrections —10°.3, —11°.7, and —10°.5, respectively.

March, 1861. The readings by No. 3 were referred to No. 4 by applying the correction (with sign reversed) as made out from the comparisons.

April, 1861. All the readings preceding 2 P. M. on the 5th, taken by thermometer No. 4, were referred to No. 13.

Daily Mean Temperature of the Air, in shade, observed at Port Foulke.

Twelve observations a day, taken at equi-distant intervals, give so nearly the same result as hourly observations (within less than ±0°.04) that no further correction is required. The values of the daily mean temperature, given in the table, were obtained by adding the correction for error of graduation to the daily means as set out in the preceding record.

[1] Occasional omissions in the record were supplied by interpolation before any means were taken. As this interpolation was made in the most simple manner, the interpolated values themselves need not be shown.

Day of the month.	1860. Sept.	Oct.	Nov.	Dec.	1861. Jan'y.	Feb.	March.	April.	May.	June.	July.
1	+23°.4	+16°.1	+0°.7	+9°.9	—21°.8	—21°.7	—21°.5	—17°.7	+3°.3	+21°.3	+39°.1
2	22.1	21.4	—1.0	+2.7	—27.6	—17.8	—13.1	—19.0	2.9	21.1	37.3
3	23.9	21.4	—3.3	—12.7	—30.9	—29.7	—16.6	—22.1	8.9	21.4	41.8
4	21.2	25.5	—0.8	—15.8	—27.9	—23.7	—23.9	—20.6	13.5	26.9	38.6
5	21.8	23.0	—5.3	—4.8	—26.7	—23.0	—33.4	—15.5	14.6	29.0	41.8
6	28.7	22.2	—8.4	—11.8	—29.7	—23.5	—32.2	—14.6	23.2	27.0	41.2
7	25.9	24.7	—3.4	—18.8	—23.1	—30.4	—25.0	—21.1	22.5	29.4	43.6
8	24.4	28.1	+11.2	—19.8	—19.2	—26.8	—17.3	—21.8	27.9	29.2	39.8
9	25.9	26.2	+12.4	—22.4	—19.4	—22.8	—14.1	—19.1	29.3	35.3	42.7
10	26.4	16.0	+6.6	—25.3	—21.9	—27.5	—14.9	—18.9	32.0	33.5	40.8
11	30.5	11.9	+4.8	—17.3	—12.5	—21.5	—15.3	—21.0	30.0	34.4	39.3
12	26.8	12.1	+5.7	—18.2	—17.0	—22.3	—18.0	—11.6	33.6	33.9	47.9
13	25.6	+6.5	+4.7	—14.5	—18.3	—33.4	—26.0	—12.2	35.8	34.1	38.8
14	24.0	—1.4	+5.9	—19.9	—9.8	—31.5	—28.7	—13.0	33.5	36.0	41.1
15	25.4	—5.5	—0.3	—11.4	—20.2	—35.3	—30.3	—13.1	33.2	36.0	41.8
16	30.6	+1.9	—2.7	—19.8	—28.4	—34.3	—31.4	—11.2	32.0	33.7	36.9
17	24.6	+2.7	—2.5	—4.1	—24.8	—31.1	—28.2	—5.8	27.3	35.0	38.8
18	21.2	+1.2	—4.5	—2.3	—28.4	—27.2	—24.6	—3.6	20.4	35.6	40.1
19	18.4	—4.2	—11.4	—4.5	—24.2	—31.6	—20.8	—0.6	16.9	35.3	39.4
20	19.7	+4.8	—15.8	—8.7	—33.5	—18.1	—22.1	+0.7	16.8	37.3	39.6
21	23.7	—1.3	—9.2	—17.6	—30.1	—14.8	—28.2	—3.3	20.9	40.0	37.5
22	26.4	+4.4	0.0	—20.6	—31.3	—20.1	—30.8	—5.6	22.2	41.2	37.6
23	17.3	—1.0	+3.3	+2.0	—40.5	—19.3	—31.0	—5.2	20.9	41.4	35.8
24	20.0	—4.7	+1.1	+1.5	—30.3	—20.6	—34.3	—2.7	24.1	39.7	35.9
25	20.2	—7.0	+9.8	—11.0	—34.2	—20.5	—22.9	—9.8	24.9	39.3	34.3
26	18.0	—7.7	+10.1	—15.1	—29.6	—22.1	—26.0	—8.3	30.6	38.7	40.9
27	18.5	—5.0	+16.6	—20.5	—23.1	—23.5	—16.2	—7.2	32.2	37.8	42.2
28	19.4	—3.0	+25.6	—15.2	—24.9	—22.4	—6.8	—7.2	30.3	37.6	53.1
29	9.7	—0.1	+20.0	—15.3	—27.4		—12.5	—2.3	28.5	37.2	49.4
30	11.4	+3.1	+15.4	—23.9	—29.8		—10.9	+3.0	24.4	37.2	43.2
31		+1.3		—21.8	—35.6		—14.9		20.2		36.6
Mean,	+22.60	+7.60	+2.84	—12.81	—25.97	—24.88	—22.32	—11.01	+23.77	+33.85	+40.54

Annual Fluctuation of the Temperature of the Air.

The annual fluctuation of the temperature at Port Foulke is represented by the above monthly means and an interpolated value for the month of August. For the purpose of comparison and interpolation the observed mean temperatures at Van Rensselaer Harbor[1] and at Port Kennedy[2] are placed together with the corresponding values at Port Foulke. The interpolated temperature for August is obtained as follows: August warmer than June at Van Rensselaer Harbor, 1°.70; at Port Kennedy, 1°.84; mean, 1°.77; which, added to the observed temperature of June at Port Foulke, gives 35°.62 for the temperature of August. In the same manner the comparison of the July and August temperature gives August colder than July 4°.77, hence temperature of August 35°.77. Again, the comparisons with September give for the preceding month 37°.55, giving to this last value the weight one-half, and to the others the weight one each, the temperature for August becomes 36°.07, all expressed in degrees of Fahrenheit's scale.

[1] Middle of page 29 of discussion of Dr. E. K. Kane's Observations.

[2] Second table of page 20 of discussion of Sir F. L. M'Clintock's Observations.

	Port Foulke. 1860-61. $\phi = 78°\ 18'$ $\lambda = 73°\ 00'$	Van Rensselaer. 1853-4-5. 78° 37' 70° 53'	Port Kennedy. 1858-9. 72° 01' 94° 14'
January	−25.97	−28.22	−34.10
February	−21.88	−26.43	−37.08
March	−22.32	−34.88	−18.22
April	−11.01	−10.35	−2.92
May	+23.77	+13.45	+15.04
June	+33.85	+30.12	+35.11
July	+40.54	+38.19	+40.12
August	(+36.07)	+31.82	+36.95
September	+22.60	+13.45	+25.43
October	+7.60	−3.58	+7.44
November	+2.84	−21.95	−11.60
December	−12.84	−31.12	−33.63
Spring	−3.19	−10.59	−2.04
Summer	(+36.82)	+33.38	+37.40
Autumn	+11.01	−4.03	+7.09
Winter	−21.22	−28.59	−35.04
Year.	(+5.86)	−2.46	+1.85

At Port Foulke every month, excepting April, was warmer than the corresponding month at Van Rensselaer Harbor, and on the average of the year the temperature was 8°.32 milder than at the latter place, and 4°.01 milder than at Port Kennedy. Port Foulke agrees more nearly with Port Kennedy in not showing the excessive cold spring and cold autumn of Van Rensselaer, but differs most conspicuously from either by a mild winter. The summer temperatures differ least, as the presence of ice and perpetual snow tends to keep the temperature near the freezing point. The range of the summer and winter mean temperature is 58°.0, at Van Rensselaer Harbor 62°.0, and at Port Kennedy 72°.4. This difference between the extreme seasons is gradually increasing as we proceed northward on the west coast of Greenland, thus—

Jacobshaven	ϕ = 69°	12′	difference	41°.6
Omenak	70	41	"	45.8
Upernavik.	72	47	"	47.7
Wolstenholm Sound . . .	76	33	"	66.7
Port Foulke	78	18	"	58.0
Van Rensselaer Harbor . .	78	37	"	62.0

The difference of Wolstenholm Sound appears to be anomalous and must be accounted for by local influences.

To express the observed temperature fluctuations analytically by means of Bessel's periodic function, requires, strictly, months of equal length, especially when the annual range of temperature is considered. This is effected in the present investigation[1] by dividing the year into twelve normal months of 30.42 (nearly) days, and

[1] In the meteorological discussions for Van Rensselaer Harbor and Port Kennedy an attempt was made to do this by an approximate method, but the following strict process, now pursued, will not be found too laborious. For common years: Retain only 0.42 of January 31 as belonging to that

of 30.5 days for common and leap years respectively. New monthly sums and means were then taken.

In the formula[1]

$$T = A + B_1 \sin(\theta + C_1) + B_2 \sin(2\theta + C_2) + B_3 \sin(3\theta + C_3) + \ldots\ldots$$

T represents the temperature for any part (month or day) of the year, and the angle θ counts from January 1st (0^h A. M.) at the rate of 30° a month or 59′.2 and 59′.0 a day for common and leap years.

For Port Foulke we have:—

$$T = +6^\circ.06 + 33^\circ.11 \sin(\theta + 242^\circ\ 14') + 6^\circ.32 \sin(2\theta + 119^\circ\ 3') + 0^\circ.74 \sin(3\theta + 318^\circ)$$

For comparison, the expression for Van Rensselaer Harbor was found:—

$$T = -2^\circ.20 + 35^\circ.59 \sin(\theta + 251^\circ\ 43') + 6^\circ.72 \sin(2\theta + 69^\circ\ 47') + 3^\circ.20 \sin(3\theta + 17^\circ)$$

And for Port Kennedy:—

$$T = +2^\circ.02 + 39^\circ.20 \sin(\theta + 249^\circ\ 05') + 0^\circ.80 \sin(2\theta + 256^\circ\ 56') + 1^\circ.06 \sin(3\theta + 275^\circ)$$

The observed and computed mean monthly temperatures compare as follows; the months are of equal length, and it will be seen that the temperatures of the actual months differ but little from those of the normal months.

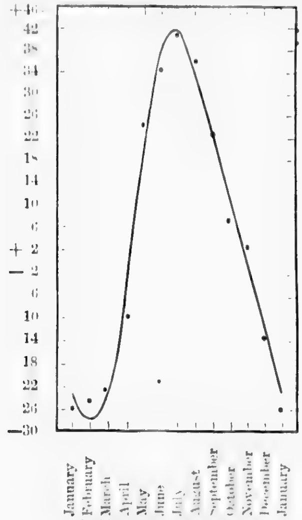
Normal month.	Port Foulke, 1860–61		
	Observed temperature.	Computed temperature.	Difference O.—C.
January	—25°.97	—22°.94	—3°.03
February	—24.63	—27.90	+3.27
March	—22.41	—22.79	+0.38
April	—9.95	—5.25	—4.70
May	+24.81	+18.98	+5.83
June	+34.52	+37.43	—2.91
July	+40.53	+41.56	—1.03
August	(+36.07)	+33.88	+2.19
September	+22.50	+22.27	+0.23
October	+7.46	+10.87	—3.41
November	+2.96	—0.72	+3.68
December	—13.18	—12.67	—0.51
Seasons and year.			
Spring	—2.52	—3.02	+0.50
Summer	(+37.04)	+37.62	—0.58
Autumn	+10.97	+10.81	+0.16
Winter	—21.26	—21.17	—0.09
Year	+6.06	+6.06	0.00

month (and consequently cast over 0.58 of it to February); include with February, March 1, and 0.83 of the second; with March, April 1 and 0.25 of the second; with April, May 1 and 0.67 of the second; with May, June 1 and 0.08 of the second; with June, July 1 and 0.50 of the second; with July 0.92 of August 1; with August 0.33 of September 1; with September 0.75 of October 1; with October 0.17 of November 1; with November 0.58 of December 1. For leap years: Retain only 0.5 of January 31, casting the other half into February; with February include March 1; with March 0.5 of April 1; with April May 1; with May 0.5 of June 1; with June July 1; with July 0.5 of August 1 (leaving the other half to be counted in with August); with September include 0.5 of October 1; and with November 0.5 of December 1.

[1] For a further development of these functions to suit various numbers of observations in a cycle, see U. S. Coast Survey Report for 1862, Appendix No. 22.

The average representation of the mean temperature of any one month is +2°.4, and of the mean annual temperature +0°.7. According to the above formula the warmest day is July 15th, temperature +41°.6, and the coldest day February 16th, temperature, —28°.0. The annual mean temperature is reached on April 22d, and November 14th. On the annexed diagram the curve represents the computed annual fluctuation, and the dots the observed mean monthly temperatures.

ANNUAL FLUCTUATION OF THE TEMPERATURE OF THE AIR AT PORT FOULKE.



(Middle of each month.)

The monthly range, that is, the difference of the highest and lowest mean temperature of any day of the month, is greatest in November (41°), and least in July (19°).

The lowest temperature recorded (and corrected for index error) was —45°.4 on January 25th, 1861, 6 A. M., and the highest temperature recorded was +61°.0 on July 5th, 1861, 2 P. M. On the 28th of July, 1861, at Cape Isabella, in nearly the same latitude as Port Foulke, the temperature rose to +63°.0 at 10 A. M.; the vessel was then among the floe ice.[1] The extreme range of temperature experienced was therefore 108°.4 of Fahrenheit's scale; at Van Rensselaer Harbor the extreme range was 117°.2, and at Port Kennedy 104°.8.

The difference in temperature of the atmosphere at Port Foulke and Van Rensselaer Harbor, due to the cause stated in the introduction to the meteorological part,

[1] The minima thermometers (1597 and 1639) were exposed too late in the winter (March 1st) to record the lowest temperature. The maxima thermometers (1705 and 1657) recorded +67°.0 June 22d; but the two instruments differed then 8° in their indications, and their errors of graduation were not determined. No. 1657 broke July 2d, and No. 1705 was not read after July 12, 1861.

we have found to be 8½° on the average during the year. In March, 1861, Dr. Hayes visited the harbor, and recorded the following temperatures by thermometer No. 10.

March 18th 10 P. M.	Temperature	—47°	Wind N.	Force	2
" 19th 8 A. M.	"	—26 (in sun)	Calm		
" 19th 9 P. M.	"	—48	Wind N. by E.	"	2
" 20th 6 A. M.	"	—66.5	" N.	"	1
" 20th 9 P. M.	"	—46	" N.	"	2
" 21st 6 A. M.	"	—68	" N.	"	1
" 21st Noon	"	—50	" N.	"	5

Applying the correction for errors of graduation, we obtain the following comparisons of temperature.

	Port Foulke.	Van Rensselaer.	Difference (R—F).
March 18th 10 P. M.	—30°.7	—43°.4	—12°.7
" 19th 9 P. M.	—16.9	—44.4	—27.5
" 20th 6 A. M.	—16.4	—62.9	—46.5
" 20th 9 P. M.	—28.2	—42.4	—14.2
" 21st 6 A. M.	—31.2	—64.4	—33.2
" 21st Noon	—25.0	—46.4	—21.4

The average difference on these four days is 26° nearly, and the greatest difference observed, March 20, 6 A. M., is 46½°, Van Rensselaer Harbor being so much colder. The greatest cold recorded by Dr. Kane (February 5th, 1854) was —66°.4, which exceeds the above on March 21 A. M., by 2° only; the month of March was decidedly the coldest month according to Dr. Kane's observations.

During the above four days of comparison the wind at Port Foulke was N. E. on the average; at Van Rensselaer Harbor it was N.

Diurnal Fluctuation of the Temperature of the Air.

Taking monthly means of the observed temperature at each hour of the day, and referring the readings by thermometers No. 7 and 6, in November, to thermometer No. 3 used during the second half of that month, we have the following bi-hourly mean values from which to deduce the diurnal fluctuations.

Month.	A. M.						P. M.						Thermometer
	2ʰ	4	6	8	10	Noon.	2	4	6	8	10	12ʰ	
September	+20°.95	+21°.26	+21°.42	+21°.60	+21°.73	+22°.19	+22°.48	+22°.37	+21°.77	+21°.60	+21°.26	+20°.48	7
October	+5.72	+5.79	+5.57	+6.11	+6.84	+7.53	+7.77	+7.71	+7.30	+7.09	+6.18	+5.87	7
November	+2.06	+1.98	+2.92	+2.79	+2.98	+3.22	+3.26	+3.64	+3.87	+3.54	+3.42	+2.49	3
December	—9.55	—10.43	—10.91	—11.32	—10.76	—10.66	—10.56	—9.69	—10.78	—10.73	—11.36	—10.16	4
January	—23.47	—23.11	—23.63	—22.66	—22.42	—22.23	—22.84	—23.18	—23.09	—23.89	—23.21	—23.11	4
February	—23.82	—24.07	—22.95	—21.27	—21.27	—21.09	—20.11	—21.20	—21.56	—21.75	—21.63	—22.75	4
March	—22.29	—22.97	—22.39	—20.24	—19.55	—17.98	—14.64	—15.96	—18.10	—19.14	—20.48	—21.78	4
April	—13.63	—14.07	—12.50	—10.67	—10.02	—8.79	—8.00	—8.94	—9.89	—10.55	—12.39	—12.97	13
May	+18.34	+20.26	+21.43	+23.62	+24.43	+24.92	+24.60	+24.35	+24.00	+22.19	+20.61	+19.48	13
June	+30.78	+32.30	+33.25	+33.85	+35.07	+35.78	+36.59	+35.88	+35.15	+34.08	+32.57	+31.58	13
July	+39.37	+39.79	+40.21	+42.22	+43.33	+42.98	+44.78	+44.51	+43.18	+42.14	+41.69	+39.16	13

The above figures were next referred to standard thermometer No. 3, and further corrected for effect of annual change. The diurnal effect of this change was computed by the preceding formula for *T*, and the daily increase of temperature found as follows:—

January	−0°.28	July	[illegible]
February	−0.02	August	[illegible]
March	+0.39	September	[illegible]
April	+0.77	October	[illegible]
May	+0.78	November	−0.40
June	+0.38	December	[illegible]

for the middle of each month. Without regard to sign, one-half of these quantities will be the correction for 0ʰ A. M. and 12 P. M.; at noon there is, of course, no correction, and for the intermediate hours the correction is proportional to the interval from noon; the A. M. and P. M. corrections at the same hours are the same, but with signs reversed. An examination of the diurnal fluctuation in July, August, and September, at Van Rensselaer Harbor and at Port Kennedy, shows that the August value is quite well represented by a mean of the July and September values; the August value for Port Foulke has consequently been interpolated by means of the two adjacent months.

Diurnal fluctuation of the temperature.

(Corrected for errors of graduation of thermometers, and for effect of annual change.)

Month.	A. M. 2	4	6	8	10	N.	P. M. 2	4	6	8	10	12
January	−26°.67	−26°.27	−26°.81	−25°.74	−25°.47	−25°.24	−25.86	−26.21	[illegible]	−25.84	[illegible]	[illegible]
February	−26.96	−27.23	−26.01	−24.21	−24.21	−24.01	−22.99	−24.14	[illegible]	[illegible]	[illegible]	[illegible]
March	−25.14	−25.90	−25.30	−23.04	−22.34	−20.66	−17.03	−18.51	−20.89	−22.04	[illegible]	[illegible]
April	−13.74	−14.18	−12.90	−11.38	−10.86	−9.56	−8.76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	+20.28	+22.18	+23.33	+25.50	+26.27	+26.72	+26.33	[illegible]	[illegible]	+23.67	[illegible]	+20.71
June	+32.41	+33.78	+34.64	+35.18	+36.30	+36.82	+37.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	+39.48	+39.80	+40.15	+41.68	+42.52	+42.26	[illegible]	+43.45	+42.44	+41.66	[illegible]	[illegible]
(August)	+30.58	+30.92	+31.21	+32.11	+32.59	+32.73	[illegible]	+33.46	[illegible]	[illegible]	[illegible]	[illegible]
September	+21.79	+22.13	+22.32	+22.54	+22.70	+23.19	+23.51	+23.43	+22.87	+22.71	+22.42	[illegible]
October	+6.56	+6.66	+6.47	+7.05	+7.81	+8.53	+8.80	+8.77	+8.40	+8.22	[illegible]	[illegible]
November	+1.90	+1.85	+2.82	+2.73	+2.95	+3.22	+3.29	+3.70	+3.97	+3.67	[illegible]	[illegible]
December	−11.56	−12.84	−13.00	−13.41	−12.76	−12.63	−12.48	−11.50	−12.65	−12.57	[illegible]	[illegible]

If we subtract from each value the respective monthly mean, the residuals will represent the diurnal fluctuation proper, a + sign indicates higher, a — sign lower temperature than the mean of the day. The last two lines show the diurnal fluctuation for Van Rensselaer and Port Kennedy for comparison.

Month.	A. M.						P. M.					
	2h	4	6	8	10	Noon.	2	4	6	8	10	12h
January . .	−0°.64	−0°.24	−0°.78	+0°.29	+0°.56	+0°.79	+0°.17	−0°.18	−0°.06	+0°.19	−0°.13	−0°.01
February . .	−2.01	−2.28	−1.06	+0.74	+0.74	+0.94	+1.06	+0.81	+0.42	+0.22	+0.35	−0.83
March . .	−2.70	−3.46	−2.80	−0.60	+0.10	+1.78	+5.41	+3.03	+1.55	+0.40	−1.07	−2.52
April . . .	−1.99	−2.43	−1.15	+0.37	+0.89	+2.10	+2.39	+1.89	+0.75	+0.10	−1.56	−2.12
May . . .	−3.77	−1.87	−0.72	+1.45	+2.22	+2.67	+2.28	+1.96	+1.53	−0.38	−2.07	−3.31
June . . .	−2.70	−1.33	−0.47	+0.07	+1.19	+1.71	+2.29	+1.74	+1.11	+0.10	−1.30	−2.31
July . . .	−2.01	−1.69	−1.34	+0.19	+1.03	+0.77	+2.19	+1.96	+0.95	+0.17	−0.14	−2.07
August . .	−1.47	−1.13	−0.84	+0.06	+0.54	+0.68	+1.56	+1.41	+0.64	+0.18	−0.12	−1.45
September .	−0.81	−0.47	−0.28	−0.06	+0.10	+0.59	+0.91	+0.83	+0.27	+0.13	−0.18	−0.92
October . .	−1.08	−0.98	−1.17	−0.59	+0.17	+0.89	+1.16	+1.13	+0.76	+0.58	−0.30	−0.57
November .	−1.13	−1.18	−0.21	−0.30	−0.08	+0.19	+0.26	+0.67	+0.94	+0.64	+0.55	−0.34
December . .	+0.28	−0.30	−0.46	−0.87	−0.22	−0.05	+0.06	+1.04	−0.11	−0.03	−0.69	+0.65
Spring . . .	−2.82	−2.59	−1.58	+0.41	+1.07	+2.21	+3.56	+2.59	+1.29	+0.04	−1.57	−2.65
Summer . .	−2.06	−1.38	−0.88	+0.11	+0.92	+1.05	+2.01	+1.70	+0.90	+0.15	−0.54	−1.94
Autumn . .	−1.01	−0.88	−0.55	−0.32	+0.06	+0.56	+0.78	+0.88	+0.66	+0.45	+0.02	−0.61
Winter . .	−0.56	−0.94	−0.77	+0.05	+0.36	+0.55	+0.73	+0.56	+0.08	+0.13	−0.16	−0.06
P. F. Year .	−1.61	−1.45	−0.94	+0.06	+0.60	+1.09	+1.77	+1.43	+0.73	+0.19	−0.56	−1.32
V. R. Year .	−1.74	−1.55	−0.90	+0.17	+1.06	+1.81	+1.90	+1.40	+0.73	−0.16	−1.02	−1.64
P. K. Year .	−1.87	−1.50	−0.80	+0.25	+1.50	+2.25	+2.02	+1.34	+0.29	−0.50	−1.13	−1.87

The diurnal variation, on the average during a year, as deduced for Port Foulke and Van Rensselaer Harbor, shows a remarkable accordance for these localities; the range at the former place is a little smaller than at the latter, viz: 3°.38 and 3°.64, which is due to the equalizing effect of open water. The warmest and coldest observing hours are 2 P. M. and 2 A. M. The range at Port Kennedy is a little greater than the above, 4°.12, on account of its smaller latitude. The spring, summer, autumn, and winter ranges at Port Foulke were as follows; 6°.38, 4°.07, 1°.89, and 1°.67, respectively. In the month of December, when the sun is most depressed below the horizon, the diurnal variation becomes less regular, and approaches towards vanishing altogether.

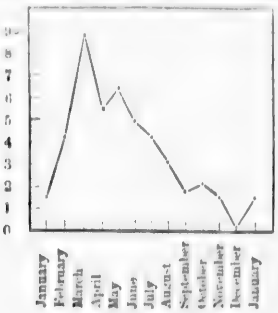
Annual Inequality of the Diurnal Fluctuation of the Temperature.

The annual inequality is best exhibited by the monthly mean values of the diurnal range; these values for Port Foulke, Van Rensselaer Harbor, and Port Kennedy, are as follows:—

Daily range of temperature.							
	Port Foulke.	Van R.	Port Ken.		Port Foulke.	Van R.	Port Ken.
January,	1°.43	1°.55	1°.41	July,	4°.26	3°.37	6°.97
February,	4.24	3.07	1.49	August,	3.03	5.30	2.63
March,	8.87	5.66	9.55	September,	1.83	5.55	2.94
April,	5.42	9.09	7.42	October,	2.24	1.67	2.18
May,	6.44	7.34	7.94	November,	1.55	1.00	2.17
June,	4.99	5.10	9.60	December,	0.18	1.65	0.84

This table exhibits more strikingly the difference in the climate of the two localities which at Port Foulke is the more equable. To obtain the November and December range, which is marked by the accidental irregularities of the temperature, an average value near the hours of maxima and minima has been used.

ANNUAL INEQUALITY IN THE DIURNAL AMPLITUDE OF THE TEMPERATURE AT PORT FOULKE.



The daily range is greatest in spring, in March it attains its maximum value, then falling a little and rising again in May, it diminishes till December, when it reaches its minimum value. The great rise in spring is due to the immediate effect of the sun *before* it has power enough to melt a sufficient quantity of ice to check it. The small depression of the curve, in the spring and early summer, and shown by the three localities discussed, is most likely due to the increasing vapor. A more full material for discussion would probably bring out a small increase in the range late in summer or early in autumn, at a time when the freezing process again comes into powerful action. Of such an increase we have at present only a trace.

In the following expression of the diurnal fluctuation during the whole year, the angle θ counts from midnight at the rate of 15° an hour. To this expression those for the other localities were added for comparison.

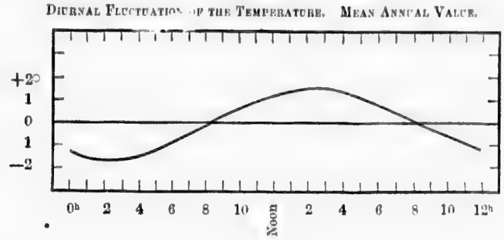
Port Foulke, $t = +1^\circ.57 \sin(\theta + 235^\circ 8') + 0^\circ.02 \sin(2\theta + 195^\circ) + 0^\circ.11 \sin(3\theta + 148^\circ)$

Van Rensselaer, $t = +1.85 \sin(\theta + 244\ 55) + 0.08 \sin(2\theta + 97) + 0.03 \sin(3\theta + 308)$

Port Kennedy, $t = +2.02 \sin(\theta + 252\ 57) + 0.25 \sin(2\theta + 117) + 0.09 \sin(3\theta + 251)$

The probable error of any single representation, for Port Foulke, is $\pm 0^\circ.08$.

DIURNAL FLUCTUATION OF THE TEMPERATURE. MEAN ANNUAL VALUE.



According to the formula the temperature rises till $2\frac{1}{2}$ P. M., when it attains its greatest value; it reaches its lowest value at $2\frac{1}{2}$ A. M., and its average value about 8 A. M. and 8 P. M.

Supposed Dependence of the Winter Temperature on the Lunar Phases.

The supposed lower temperature about the time of full moon when compared with that about new moon, during mid-winter, noticed by some Arctic explorers, and which received confirmation from observations during two winters at Van Rensselaer Harbor, and partial confirmation from observations during two winters in Baffin Bay and at Port Kennedy, is not sustained by the observations at Port Foulke, as may be seen from the following collection of mean daily temperatures, each the mean of five days, two of which precede and two of which follow the lunar phase; to allow for the annual change of temperature the *alternate* means are set out. These alternate mean temperatures, and the observed temperatures, are then compared by subtracting the temperature at the new moon from that at full moon; a negative sign indicates greater cold at full than at new moon.

	Observed temperature.	Alternate means.	Difference ○ — ●
○ October 29, 1860	—0°.7		
● November 13, "	+4.5	+8°.4	+3°.9
○ November 28, "	+17.5	—7.2	+24.7
● December 12, "	—19.0	—0.2	+18.8
○ December 28, "	—18.0	—18.4	+0.4
● January 11, 1861	—17.8	—23.2	—5.4
○ January 26, "	—28.5	—21.7	—6.8
● February 9, "	—25.7	—24.8	+0.9
○ February 25, "	—21.2	—21.6	+0.4
● March 11, "	—17.6	—21.2	—3.6
○ March 26, "	—21.3	—17.9	—3.4
● April 10, "	—18.2	—13.8	+4.4
○ April 24, "	—6.2	+5.1	—11.3
● May 9, "	+28.4		

If we take the differences from the middle of December to the end of March, the temperature would appear 2°.5 colder at full than at new moon; the high temperature about November 28, and the low temperature about December 12, however, are such strong contradictions to the supposed law, as to deprive the results collected by the expedition of any decisive value. About November 28, the prevailing wind was S. W., charged with heat and vapor from the open water spaces of North Baffin Bay; about December 12, the prevailing wind was N. E. Neither Port Foulke nor Port Kennedy are favorably situated for the experimental study of the phenomenon.

Relation of the Atmospheric Temperature to the Direction of the Wind.

The method pursued to ascertain the elevating or the depressing influence of the various winds on the temperature of the air, is as follows: The average daily temperature for each day of the year was computed by means of the expression for T, this was readily done by the use of the formula for a number of equi-distant intervals, and by the application of the principle of interpolation "into the middle" (which secures the proper value to third differences inclusive). The previously used correction for graduation of thermometers was next applied *with sign reversed* so as

to give the daily normal reading for comparison with the actual reading on that day as observed. For the hours 8 A. M. and 8 P. M. this comparison is strict since the diurnal fluctuation at these hours is nil; but for the comparisons of 2 A. M. and 2 P. M. a new set of tables of normal temperatures were constructed by applying the correction for maximum diurnal fluctuation at these hours to our first table of normals. We thus have four comparisons, at equal intervals, four observations each day; these differences of temperature were tabulated and inserted in the proper column for the direction of the wind then observed. There were nine such columns, one for each of the eight principal directions and one for calms. The mean difference for each wind, for a period extending over a season, very nearly indicates the elevating or depressing influence of each wind. A + sign indicates warmer, a — sign colder temperature than the normal. An extension of this investigation to twelve hours a day would only add to the labor without materially affecting the result. By the process adopted the influence of the wind will be found independent of the annual and diurnal fluctuation of temperature, and any possible tendency of the wind to blow from a certain direction at the same time each day can be taken into account.

The results for the hours 2 A. M., 8 A. M., 2 P. M., and 8 P. M., do not materially differ; thus for the N. E. wind we find at these hours —1°.9, —2°.1, —1°.7, and —1°.8 respectively, and for the warmer S. W. wind at the same hours, +2°.6, +0°.5, +1°.0, and +0°.4.

As there are but few entries of winds from the north, east, south, west, and northwest, the results were contracted in two means, one for the winter half of the year (October to March inclusive), the other for the summer half (April to September inclusive). The blanks in the table indicate too few observations to give any reliable result; numbers between brackets are of little value.

Elevating (+) or depressing (—) effect of the winds on the temperature of the air

	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Calm.
Winter half year	+2°.5	—1°.6	- - - -	+3°.5	- - - - -	+5°.1	- - - - -	- - - - -	—2 2
Summer "	—0.2	—2.2	- - - -	—0.3	- - - - -	—1.1	- - - - -	- - - - -	+3.0
Year	+1.3	—1.9	—1°.1	+2.4	(+8°.7)	+1.2	(+9°.8)	(—0°.3)	—0.3
Number of entries	36	637	7	49	7	225	11	7	374

The northeast and east winds are cold winds, the southeast, south, southwest (and probably west also) are warm winds; calms depress the temperature. The northeast wind is cold all the year round, and the southwest is warm, particularly in the winter; during winter calms are accompanied by a lower temperature; during summer by a high temperature, in opposition to the winds. The distribution of the winds is very irregular; the prevailing wind, northeast, blows longer than all the other winds together, in which time that of the calms may also be included.

If we take for the effect of south and west winds the mean of the effect of the adjacent winds, and subtract 0°.5 from all numbers, we find the values given below.

True direction of wind.	Port Foulke $\phi = 78^\circ 18'$ $\lambda = 73\ 00$	Van Rensselaer $\phi = 78^\circ 37'$ $\lambda = 70\ 53$
N.	$+0^\circ.8$	$-1^\circ.4$
N. E.	-2.4	0.0
E.	-1.6	-0.1
S. E.	$+1.9$	$+0.9$
S.	$+1.3$	$+0.6$
S. W.	$+0.7$	$+0.4$
W.	-0.1	$+0.1$
N. W.	-0.8	-1.4

We have, therefore, for comparison the following expressions[1]:—

Port Foulke . . . . $\tau = +\ 1^\circ.2\ sin\ (\theta + 249^\circ) + 1^\circ.2\ sin\ (2\theta + 126^\circ)$
Van Rensselaer Harbor . . $\tau = +\ 1.0\ sin\ (\theta + 286\ ) +\ 0.3\ sin\ (2\theta + 335\ )$
Baffin Bay ($\phi = 72^\circ.5$, $\lambda = 65^\circ.8$) $\tau = +\ 1.5\ sin\ (\theta + 338\ ) +\ 0.8\ sin\ (2\theta + 173\ )$
Port Kennedy . . . . $\tau = +\ 0.9\ sin\ (\theta + 320\ ) +\ 0.4\ sin\ (2\theta +\ 26\ )$

The angle θ counts from the north (or belongs to a true north wind) in the direction east, south, etc.

Effect of a fall of Snow (or Rain) on the Temperature.

The effect produced by the change of latent into sensible heat, during the precipitation of snow (or rain), is far greater than the effect of the variation in the direction of the winds.

At Port Foulke it snowed on 94 days in *eleven* months; the total number of hours of precipitation during this time was 656. It rained on 15 days in June, and July, and November; total number of hours 79. This is considerably more snow and rain than at Van Rensselaer Harbor, where Dr. Kane noted snow during 680 hours, and rain during 60 hours, in *seventeen* months. The snowy and rainy days are distributed over the year as follows:—

In September . . .	6	In March	8
" October . . .	10	" April	8
" November . . .	12	" May	9
" December . . .	4	" June	16
" January . . .	8	" July	13
" February . . .	7		

The *elevating* effect on the *winter* temperature is as decidedly brought out as the *depressing* effect on the *summer* temperature; the former, however, is six times as great as the latter. If we compare the observed temperature (at the hours 2 A. M. and P. M., and 8 A. M. and P. M.) with the corresponding normal temperature during each fall of snow (or rain) according to the method pursued in the preceding investigation, we find from 85 cases in the winter half of the year (October to March inclusive) the elevating effect on the average $= 8^\circ.6$, and from 86 cases in the summer half of the year (April to September) the depressing effect on the average $1^\circ.5$; during the whole period, therefore (in 11 months), the average effect was $+3.^\circ5$; at Van Rensselaer Harbor the corresponding quantity was $+7^\circ.7$.

[1] See p. 30 of reduction of Sir F. L. McClintock's Meteorological Observations.

The maximum elevating effect in winter amounted to 36° (November 28, 1860), and the maximum depressing effect in summer to 9° (July 25, 1861).

This annual variation is well shown in the table given for Van Rensselaer Harbor, where the maximum effect was on the *average in January* +19°, and the opposite effect on the *average in June* —1°.3, and is, indeed, a most marked feature at either locality.

Effect of Clear and Cloudy Weather on the Temperature.

To ascertain the effect upon the temperature of a serene and cloudy atmosphere, the temperature observed on clear days (or at least three-quarters clear), and on cloudy days (or at least three-quarters cloudy), was compared with the normal temperature of the day; a + difference indicates warmer, a — difference a colder day than the normal; for this investigation the year was again divided into two seasons.

The *clear* days preponderate in the *winter* season, the *cloudy* days in the summer season; thus in

$$\left\{\begin{array}{l}\text{December}\\ \text{January}\\ \text{February}\end{array}\right. \text{ there are } \left\{\begin{array}{l}18\\ 19\\ 17\end{array}\right. \text{ clear days, and but } \left.\begin{array}{l}4\\ 1\\ 1\end{array}\right\} \text{ cloudy days, and in June and}$$

July there are 4 and 8 clear days, and 16 and 15 cloudy days.

In winter (October to March inclusive) on the average from 82 *clear* days the temperature was *lower* 3°.5 than the normal, and in summer (April to September inclusive) on the average from 41 *clear* days the temperature was *higher* 0°.8 than the normal; a clear atmosphere consequently produces opposite effects in the summer and winter seasons.

In winter on the average from 31 *cloudy* days the temperature was *higher* 7°.0, and in summer on the average from 48 days it was *lower* 2°.1 than the normal value.

The explanation of these results is obvious: In winter, under a clear sky, radiation soon lowers the temperature, whereas a clear sky in summer by permitting greater insolation, will increase the temperature. In cloudy weather in winter, radiation is stopped, and with an atmosphere nearly or quite saturated with moisture the temperature must rise; in summer insolation is prevented, and consequently the temperature will remain lower than its normal value.

Observations of the Direct Heating Power of the Sun.

For the measure of the direct heating effect of the sun, two black bulb thermometers were exposed on the floe near the ship.

B. B. thermometers, Nos. 1648 and 1704.
Temperature in sun, at Port Foulke.

	1648.	1704.	
1861. Feb'y 26th	—17°.5	—15°.5	at 2½ P. M.
" 27th	—18.0	—17.5	" "
" 28th	—15.5	—13.5	" "
March 4th	—16		at 2½ P. M., —18° at 3 P. M.
" 6th	—22	—21	at 2 P. M., —23°.5 and —21° at 3 P. M.
" 7th	—19	—18	at 3 P. M.
" 8th	—11.5	—10	at 3 P. M., —12° and —10° at 4 P. M.
" 9th	—7	—5	at 3 P. M., —9.5 and —8° at 4 P. M.
" 11th	—9	—4	"
" 12th	—12	—11	at 3 P. M., —12.5 and —12.5 at 5 P. M.
" 13th	—16	—14	at 5 P. M.
" 14th	—22	—20.5	at 3 P. M., —22 and —20.5 at 5 P. M
" 15th	—22	—18	at 5 P. M.
" 16th		—2	at 3 P. M., and —3° at 5 P. M.
" 17th		+1	"
" 22d		+1	at 3 P. M., and —7.5 at 5 P. M.
" 23d		+1	at 1 P. M., +3° at 3 P. M., +2° at 5 P. M.
" 24th		+1	at 1 P. M., —4 at 3 P. M., —8 at 5 P. M.
" 26th		—9.5	at 1 P. M., —12.5 at 3 P. M., —8 at 5 P. M.
" 29th		+6	at 1 P. M., +6 at 3 P. M., —1.5 at 5 P. M.
" 30th		—5	at 1 P. M., —2.5 at 3 P. M.
" 31st		+14	at 1 P. M., +4 at 3 P. M.
April 1st		+8	at 1 P. M., +8 at 3 P. M.
" 3d		—10	at 1 P. M., —5 at 3 P. M., 0° at 5 P. M.
" 4th		+21	at 3 P. M., —5 at 7 P. M.
" 8th		—11	at 1 P. M., —13 at 3 P. M.
" 9th		—12	at 1 P. M., —5 at 5 P. M.
" 12th		+14	at 5 P. M.
" 13th		—7	at 3 P. M.
" 14th		—6	at 1 P. M., —9 at 3 P. M.
" 15th		+1	at 3 P. M.
" 16th		+3	at 11 A. M.
" 17th		—5	at 11 A. M.
" 18th		+13	at 11 A. M., +18 at 1 P. M. Snow melting on side of ship.
" 20th		+10	at 11 A. M., +23 at 1 P. M.
			+19 at 3 P. M.
			+13 at 5 P. M.
" 22d		+17	at 1 P. M., +13 at 3 P. M., +9 at 5 P. M.
" 23d		+2	at 9 A. M., +21 at 11 A. M., +18 at 1 P. M., +5 at 3 P. M.
" 26th		+12	at 9 A. M., +28 " +15 at 5 "
" 27th		+6.5	at 1 P. M., +5 at 3 P. M., +4 at 5 P. M., 0 at 7 P. M.
" 28th		+5	at 11 A. M., +8 at 1 P. M., +5.5 at 3 P. M.
" 29th		+10	at 3 P. M.
" 30th		+13	at 11 A. M., +17 at 1 P. M., +18 at 3 P. M.
May 1st		+15	at 9 A.M., 11 A.M., 1 P.M., 3 P.M., 5 P.M., +13.5 at 7 P.M.
" 2d		+8	at 11 A. M., 5 P. M., +13 at 7 P. M.
" 3d		+25	at 11 A. M., +24 at 1 P. M., +22 at 3 P. M.
" 5th		+20	at 9 A. M., +29 at 11 A. M., +24 at 1 P. M., 3 P. M.
			+25 at 5 P. M.
" 6th		+35	at 1 P. M., 3 P. M., +35.5 at 5 P. M., +31 at 7 P. M.
" 7th		+30	at 11 A. M., +34 at 1 P. M., +32 at 3 P. M.

The above observations were made in *clear* weather.

Observations of Temperature made by Dr. Hayes on his Journey to the Northward, in April and May, 1861.

On this journey Dr. Hayes reached his extreme northern latitude, at Cape Lieber, of 81° 37′, in longitude 69¼° west of Greenwich, on the 18th of May. The following temperatures were recorded by him:—

May 5	Scouse Camp,	$\phi = 79^\circ\ 29'$	at 6 A. M.	Temp. —8	
“ 5	“ “	$\lambda = 72\ \ 53$	“ 1 P. M.	“ —2	In sun +28
“ 5	“ “		“ 6 “	“ 0	“ “ +27
“ 6	“ “		“ 7 “	“ +7	“ “ +19½
“ 7	No Hut Camp,		“ ¼ “	“ - - -	“ “ +17
“ 7	“ “		“ 4 “	“ +11½	“ “ +41
“ 8	Pipe Camp,		“ 7 A. M.	“ +14	
“ 8	“ “		“ 4 P. M.	“ +24	
“ 10	Near Cape Hawks,		noon	- - - -	+36° in sun
“ 10	“ “		“ 6½ P. M.	- - - -	+50 “
“ 11	Cape Hawks Camp,	$\phi = 79^\circ\ 44'$ $\lambda = 73\ \ 06$	“ 3 A. M.	“ +12	
“ 12	Near Cape Hawks,		“ 0 “	“ +5	+18 “
“ 12	Near Cape L. Napoleon,		“ 6 “	- - - -	+36½ “
“ 12	“ “ “		“ 4½ P. M.	“ +21	
“ 13	Foggy Comp.	$\phi = 79^\circ\ 56'$	“ 4 A. M.	“ +26	
“ 13	“ “	$\lambda = 71\ \ 28$	“ 6½ P. M.	“ +18	
“ 13	Near Frazer Camp,		“ 11¼ “	“ +9	
“ 14	Frazer Camp,	$\phi = 80^\circ\ 06'$	“ 6 A. M.	“ +26	
“ 14	“ “		“ 2½ P. M.	- - - -	+58 in sun. Light south wind
“ 14	“ “		“ 3 “	“ +28	
“ 14	“ “		“ 6 “	“ +20	
“ 15	Tired dog's Camp,		“ 2½ A. M.	“ +21	+30°
“ 15	“ “		“ 4½ P. M.	“ +23	
“ 16	Jensen's Camp,[1]	$\phi = 80^\circ\ 48'$	“ 0 A. M.	“ +20	Fog
“ 16	“ “		“ 4 “	“ +19	“
“ 16	“ “		“ 8 “	“ +22	In sun 38
“ 16	“ “		noon	“ +28	“ “ 48
“ 16	“ “		“ 4 P. M.	“ +24	“ “ 42
“ 16	“ “		“ 8 “	“ +26	“ “ 49
“ 17	“ “		“ 0 A. M.	“ +21	Fog
“ 17	“ “		“ 4 “	“ +26	“
“ 17	“ “		“ 8 “	“ +18	In sun 36°
“ 17	“ “		noon	“ +32	“ “ 40
“ 17	“ “		“ 4 P. M.	“ +20	Fog
“ 17	“ “		“ 8 “	“ +23	Snow
“ 18	“ “		“ 0 A. M.	“ +14	Wind and snow throughout the day
“ 18	“ “		“ 4 “	“ +16	
“ 18	“ “		“ 8 “	“ +18	
“ 18	“ “		noon	“ +22	
“ 18	“ “		“ 4 P. M.	“ +16	
“ 18	“ “		“ 8 “	“ +14	
“ 19	“ “		“ 0 A. M.	“ +12	Wind and snow
“ 19	“ “		“ 4 “	“ +14	
“ 19	“ “		“ 8 “	“ +14	
“ 19	“ “		noon	“ +16	
“ 20	Camp Leidy,	$\phi = 79^\circ\ 58'$	“ 2½ A. M.	“ +8	Weather thick, strong N.W. wind; light snow
“ 20	“ “		“ 4½ P. M.	“ +22	Light S. W. wind, cloudy; light snow

[1] Recorded by G. F. Knorr, during Dr. Hayes' absence

May 21	Near Deep Snow Camp,	$\phi = 79° 55'$	at 8 A. M.	Temp.	+22	Cloudy; snowing.
" 21	" "		" 7 P. M.	"	+8	
" 21	" "		" 10 "	"	—4	
" 22	Camp Hawks,	$\phi = 79° 44'$	" 8 A. M.	"	+15	Light N. W. wind; cloudy
" 22	" "	$\lambda = 73\ 06$	" 6 P. M.	"	+13	+19° in sun
" 22	" "		" $8\frac{1}{3}$ "		0	
" 23	Near Smallberg Camp,	$\phi = 79° 33'$	" 7 A. M.	"	+20	+32 "
" 23	" " "	$\lambda = 72\ 53$	" $7\frac{1}{2}$ P. M.	"	+13	+22 "
" 24	Near Broken Sledge Camp,		" 7 A. M.	"	+14	+32 "
" 24	" " "		" 6 P. M.	"	+18	
" 25	Near Potato Camp,	$\phi = 79° 04'$	" 1 A. M.	"	+19	
" 25	and near	$\lambda = 72\ 30$	" $7\frac{1}{2}$ "	"	+18	+38 "
" 26	Camp Separation,	$\phi = 78\ 53$	" 0 "	"	+4	
" 26	" "	$\lambda = 72\ 08$	" $6\frac{1}{3}$ "	"	+17	+32 "
" 26	" "		" 6 P. M.	"	+16	+30 "

To complete the record of the weather during the above period, the following note is added:—

1861. April 21. Near Cairn Point. Storm stayed
April 24. " " "

The following table contains the mean daily temperature in the shade derived from the above by application of the known average value of the diurnal variation taken from the table p. 39 of my discussion of the temperature observations at Van Rensselaer Harbor, and the preceding table of the diurnal fluctuation at Port Foulke, after changing sign in the latter.

Date. 1861. May.	Locality and latitude.		Mean temperature of day.	Port Foulke, mean temp. of day.
5	Scouse Camp,	$\phi = 79° 29'$	—4°.5	+14°.6
6	" "		+6.2	+23.2
7	No Hut Camp,		+8.9	+22.5
8	Pipe Camp,		+17.6	+27.9
9	" "		- - - - -	+29.3
10	Near Camp Hawks,		- - - - -	+32.0
11	Cape Hawks Camp,	$\phi = 79° 44'$	+15.2	+30.0
12	Near Cape Hawks,		+13.5	+33.6
13	Foggy Camp,	$\phi = 79\ 56$	+19.0	+35.8
14	Frazer Camp,	$\phi = 80\ 06$	+23.4	+33.5
15	Tired dog's Camp,		+22.6	+33.2
16	Jensen's Camp,	$\phi = 80\ 48$	+23.1	+32.0
17	" "		+23.2	+27.3
18	" "		+16.6	+20.4
19	" "		+14.5	+16.9
20	Camp Leidy,	$\phi = 79° 58'$	+15.2	+16.8
21	Near Deep Snow Camp,	$\phi = 79\ 55$	+10.1	+20.9
22	Camp Hawks,	$\phi = 79\ 44$	+8.5	+22.2
23	Near Smallberg Camp,	$\phi = 79\ 33$	+16.2	+20.9
24	Near Broken Sledge Camp,		+15.0	+24.1
25	Near Camp Separation,	$\phi = 78\ 53$	+20.0	+24.9
26	" " "		+13.0	+30.6

On the average, therefore, it was 10°.7 colder on the route across Smith Sound, and up the west coast of Kennedy Channel, that at Port Foulke. At Jensen's Camp, where we have observations on four days, it was on the average 4°.8 colder than at Port Foulke; the difference of latitude of these places is 2° 30′.

ATMOSPHERIC PRESSURE.

THE atmospheric pressure was observed by means of a mercurial barometer suspended on board the schooner; its index error, if any, is not known. The readings are given in English inches, and those of the attached thermometer in degrees of Fahrenheit.

The observations here recorded commence with September 1, 1860, and extend to August 1, 1861; the record is nearly complete for the hours 8, 10, noon, 2, 4, 6, 8, 10, P. M., but for midnight and the morning hours 2, 4, 6, it is defective, and in April, May, and June, observations at these hours are altogether wanting.

For the reduction of the readings to the temperature of freezing water, Table XVII, C, of Guyot's Meteorological and Physical Tables (Smithsonian Miscellaneous Collection) was employed.

The approximate reduction of the readings of the barometer to the level of the sea is +0.006 inches.

Readings of the barometer and attached thermometer near and at Port Foulke, Smith Strait.
September, 1860.

Day of the month.	2h		4		6		8		10		Noon	
[1]1	---	---	---	---	---	---	29in.70	67°	29in.75	52°	29in.75	55°
2	---	---	---	---	---	---	.75	58	.70	75	.80	80
3	---	---	---	---	---	---	.70	65	.70	65	.70	62
4	---	---	---	---	---	---	.70	75	.70	75	.60	60
5	---	---	---	---	---	---	.65	61	.70	76	.70	76
6	---	---	---	---	---	---	.90	76	.90	78	.90	70
7	29in.95	62°	---	---	---	---	---	---	30.10	66	30.10	70
8	---	---	---	---	---	---	30.05	64	.05	63	.00	64
9	---	---	---	---	---	---	29.95	63	29.90	62	29.90	60
10	---	---	---	---	---	---	.55	61	.50	68	.50	60
11	---	---	---	---	---	---	.50	68	.50	68	.50	74
12	.55	49	29in.56	47°	---	---	.65	67	.65	70	.60	61
13	.76	59	.75	70	29in.76	66°	.78	60	.83	61	.88	66.5
14	.98	56	.85	38	.85	34	---	---	.80	72	.75	62.5
15	.78	59	.75	77	.75	63	.85	62	.80	73	.83	83
16	.90	58	.90	72	.90	60	.88	72	.85	66	---	---
17	.75	61	.75	68	.75	72	.78	64	.75	72	.75	68
18	.82	69	.82	68	.85	41	.84	66	.81	68	.83	63
19	.92	70	.92	63	.92	73	.90	70	.92	75	.90	63
20	.87	40	.87	47	.92	74	.98	74	---	---	.90	59
21	30.01	75	30.10	75	30.15	70	30.12	75	30.15	67	30.18	62
22	.25	75	.20	70	---	---	.20	67	---	---	.10	64
23	29.60	48	29.58	63	---	---	29.50	66	29.35	60	---	---
24	.55	67	.55	65	---	---	.60	67	.60	75	29.55	68
25	.59	52	.55	59	29.52	53	.70	78	---	---	---	---
26	---	---	.63	47	72	46	.80	70	.75	70	.77	76
27	---	---	---	---	.82	63	.80	65	.75	21	---	---
28	.75	72	.80	61	.70	70	.68	58	---	---	.53	27
29	.57	64	.65	56	.55	55	---	---	---	---	.60	18
30	---	---	.63	17	.65	12	.70	23	.70	25	.70	21
Means of 30 values							29.790	64.0	29.773	63.3	29.768	60.2

[1] Barometer below deck.

Readings of the barometer and attached thermometer near and at Port Foulke, Smith Strait
September, 1860.

Day of the month.	2^h		4		6		8		10		Midnight	
1	29in.75	57°	29in.75	57°	29in.75	61	29in.75	63	29in.75	68	- - -	- -
2	.86	78	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- -
3	.70	65	.70	63	.70	65	.70	63	.75	66	- - -	- -
4	.55	62	.55	62	.55	75	.55	75	.55	73	29in.55	73
5	- - -	- - -	- - -	- - -	- - -	- - -	.80	73.5	.80	73	- - -	- -
6	.85	56	.85	65	.90	66	.95	66	.95	66	.95	63
7	30.10	67	30.05	53	30.05	60	30.05	62	30.05	47	- - -	- -
8	.00	71	.03	71	.03	68	.03	72	.00	68	- - -	- -
9	29.85	62	29.80	58	29.80	67	29.75	66	- - -	- - -	- - -	- -
10	.50	70	.50	67	.50	61	.50	66	29.50	65	- - -	- -
11	.50	70	.50	73	.53	63	.55	61	.56	55	.55	55
12	.65	61	.66	60	.67	58	.67	60	.70	65	.75	60
13	.90	66	.92	58	.93	52	.92	60	.92	72	.93	73
14	.73	72	- - -	- - -	.70	65	.70	68	.73	66	.76	66
15	.80	68	.80	68	.83	74	.77	69	.88	74	.84	74
16	.80	68	.80	70	.80	72	.78	59	.80	50	.78	65
17	.80	71	.83	65	.80	50	- - -	- - -	.82	78	.85	70
18	.83	62	.83	70	.82	70	.90	69	.92	65	.92	65
19	.90	68	.90	66	.94	71	.94	78	.94	65	.88	53
20	.95	70	.95	56	.99	72	.90	70	.99	70	30.01	65
21	30.18	62	30.20	58	30.20	68	- - -	- - -	- - -	- - -	.20	74
22	.00	64	29.80	52	29.90	51	.88	56	.80	71	29.72	61
23	29.48	50	.55	61	.35	56	.50	49	.52	47	.52	77
24	.60	70	.60	62	.55	68	.55	68	.55	73	.55	58
25	.75	63	.75	72	- - -	- - -	.75	65	.65	79	.67	62
26	.78	75	.90	79	.80	33	.81	32	.95	70	.88	62
27	.73	24	.82	73	.82	87	- - -	- - -	- - -	- - -	.66	64
28	.52	29	- - -	- - -	.60	66	.58	72	.55	71	61	70
29	.60	18[1]	.68	20	.68	19	.70	13	.60	13.5	.75	21
30	.70	25	.70	22	.70	19	.70	21	.65	20	.64	20
Means of 30 values	29.770	60.6	29.777	61.5	29.775	61.7	29.776	62.1	29.779	63.7		

[1] Barometer placed on deck.

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait.
October, 1860.

Day of the month.	2h		4		6		8		10		Noon	
1	29in.55	18°	- - -	- - -	29in.55	20°	29in.55	20°	29in.55	21°.5	29in.55	25°
2	.66	30	29in.72	28°	.80	30	.78	32	.85	27	.80	42
3	- - -	- - -	.82	35	.80	32	.85	28	.81	24	.77	23
4	.88	35	- - -	- - -	.81	33.5	.90	35	.95	40	.98	48
5	.98	44	30.04	43	- - -	- - -	30.00	48	30.00	46	.95	40
6	.87	45	29.88	44	.85	42	29.80	46	29.80	48	.80	48
7	.73	45	- - -	- - -	.90	43	.90	47	.90	49	.90	51
8	30.00	42	30.00	42	30.00	41	30.05	42	30.05	44	30.05	43
9	- - -	- - -	- - -	- - -	- - -	- - -	.15	47	.15	53	.15	50
10	- - -	- - -	- - -	- - -	- - -	- - -	.20	48	.20	53	.20	20
11	- - -	- - -	- - -	- - -	- - -	- - -	29.84	15	29.85	50	29.81	22
12	29.700	41	29.700	39	- - -	- - -	.480	48	.374	19.5	.450	53
13	- - -	- - -	- - -	- - -	- - -	- - -	.552	38	.552	43	.556	48
14	- - -	- - -	- - -	- - -	- - -	- - -	.254	23	.254	26	.250	28
15	- - -	- - -	- - -	- - -	- - -	- - -	.275	25	.275	28	.270	24
16	- - -	- - -	- - -	- - -	- - -	- - -	28.916	23	28.917	25	28.940	25
17	- - -	- - -	- - -	- - -	- - -	- - -	29.456	25	- - -	- - -	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -	- - -	.424	28	29.420	28	29.426	28
19	- - -	- - -	- - -	- - -	- - -	- - -	.666	20	.670	24	.732	28
20	- - -	- - -	- - -	- - -	- - -	- - -	.568	18	- - -	- - -	- - -	- - -
21	- - -	- - -	- - -	- - -	- - -	- - -	.430	28	.550	27	.550	27
22	- - -	- - -	- - -	- - -	- - -	- - -	.536	35	.530	36	.516	36
23	- - -	- - -	- - -	- - -	- - -	- - -	.332	28	- - -	- - -	- - -	- - -
24	- - -	- - -	- - -	- - -	- - -	- - -	.432	31	.441	32	.440	31
25	- - -	- - -	- - -	- - -	- - -	- - -	.378	28	.375	28	.356	27
26	- - -	- - -	- - -	- - -	- - -	- - -	.428	31	- - -	- - -	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -	- - -	.492	32	- - -	- - -	- - -	- - -
28	- - -	- - -	- - -	- - -	- - -	- - -	.442	25	.476	27	.542	28
29	- - -	- - -	- - -	- - -	- - -	- - -	.728	20	.754	28	.778	28
30	- - -	- - -	- - -	- - -	- - -	- - -	.778	24	.776	24	.788	31
31	- - -	- - -	- - -	- - -	- - -	- - -	.778	35	.770	35	.773	37
Mean of 31 values							29.624	31.4	29.628	33.0	29.631	33.1

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait
October, 1860

Day of the month.	2h		4		6		8		10		Midnight.	
1	29in.60	32°	29in.60	29	29in.65	28	29in.65	23	29in.70	24.5	29in.69	30
2	.85	46	.85	31	.84	26	.85	27	- - -	- - -	.85	27
3	.77	27	.85	32	.85	40	.85	36	.88	40	.98	38
4	.98	46	.98	47	.98	46	30.00	48	30.08	49	- - -	- - -
5	.95	42	.95	44	.90	54	29.90	53	29.90	52	.84	40
6	.80	40	.80	48	.80	50	.82	52	.85	53	.75	47
7	.93	48	.95	45	.95	43	.98	43	30.00	44	- - -	- - -
8	30.10	48	30.10	48	30.15	52	30.15	51	.18	50	30.20	48
9	.10	47	.05	47	.05	45	.05	45	.07	30	- - -	- - -
10	.15	20	.15	20	.10	23	.10	25	.05	25	.01	44
11	29.80	28	29.80	53	29.79	24	29.80	52	29.75	46	29.64	42
12	.430	50	.450	52	.453	52	.462	52	.462	52	- - -	- - -
13	.552	46	.552	46	.551	43	.550	43	- - -	- - -	- - -	- - -
14	.243	32	.220	32	.157	32	.157	31	.154	28	- - -	- - -
15	.268	26	.158	24	.053	24	.054	23	.054	23	- - -	- - -
16	28.940	25	28.943	23	28.953	23	.106	25	.110	25	- - -	- - -
17	- - -	- - -	- - -	- - -	29.450	25	.450	25	.391	25	- - -	- - -
18	29.450	25	29.450	25	.472	25	.470	23	.560	23	- - -	- - -
19	.676	23	.714	24	.720	24	.728	24	.716	24	- - -	- - -
20	.436	18	.434	21	.430	20	.430	21	.430	24	- - -	- - -
21	.563	28	.564	27	.564	27	- - -	- - -	- - -	- - -	- - -	- - -
22	.530	34	.550	34	.562	32	.532	32	.460	30	- - -	- - -
23	.350	29	.482	27	.450	27	.438	26	.408	25	- - -	- - -
24	.440	31	.438	30	.435	31	.435	28	.435	25	- - -	- - -
25	.358	29	.358	31	.400	31	.417	27	.418	27	- - -	- - -
26	- - -	- - -	.408	32	.420	32	.428	31	.428	31	- - -	- - -
27	.476	32	.454	32	.450	32	.442	30	.400	26	- - -	- - -
28	.576	28	.576	30	.580	30	.620	28	.620	24	- - -	- - -
29	.816	28	.816	27	.816	23	.852	23	.852	22.5	- - -	- - -
30	.788	34	.754	36	.754	36	.750	36	.747	35	- - -	- - -
31	.778	37	.784	36	.790	34	.746	34	.746	33	- - -	- - -
Mean of 31 values	29.631	33.4	29.633	34.0	29.630	33.4	29.638	33.5	29.639	32.6		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait, November, 1860.

Day of the month.	2h		4		6		8		10		Noon	
1	...	...	...	...	...	...	$29^{\text{in}}.678$	29°	$29^{\text{in}}.652$	28	$29^{\text{in}}.600$	28
2	...	...	...	...	...	...	.688	23	.752	23	.800	23
3	...	...	...	...	...	...	30.036	21	30.036	23	30.036	23
4	...	...	...	...	...	...	.112	23	.120	23	.120	23
5	...	...	...	...	...	...	.206	28	.208	28	.208	28
6	...	...	...	...	...	...	.108	23	.108	23	.086	23
7	...	...	...	...	...	...	29.772	9	29.772	15	29.772	16
8	...	...	...	...	...	...	30.100	25	30.150	30	30.186	35
9	...	...	...	...	...	...	29.952	36	29.904	37	29.908	38
10	...	...	...	...	...	...	30.478	36	30.550	35	30.572	35
11	...	...	...	...	...	...	.728	34	.726	36	.718	40
12	...	...	...	...	...	...	.522	38	.500	35	.478	34
13	...	...	...	...	...	...	.456	35	.448	35	.312	36
14	...	...	...	...	...	...	.152	25	.116	25	.090	25
15	...	...	...	...	...	...	29.972	20	29.956	21	29.932	22
16	...	...	...	...	...	...	.772	25	.742	26	.700	21
17	...	...	...	...	...	...	.628	25	.636	25	.700	25
18	...	...	...	...	...	...	.820	25	.844	25	.852	25
19	...	...	...	...	...	...	.812	24	.810	25	.800	25
20	...	...	...	...	...	...	.830	21	.852	21	.900	22
21	...	...	...	...	...	...	30.074	30	30.046	27	30.092	32
22	...	...	...	...	...	...	29.950	25	29.916	25	29.876	25
23	...	...	...	...	...	...	.926	28	.984	30	30.006	30
24	...	...	...	...	...	...	.972	25	30.000	25	.078	25
25	...	...	...	...	...	...	30.700	35	.724	35	.746	36
26	...	...	...	...	...	...	.632	28	.586	30	.484	29
27	$30^{\text{in}}.146$	23°	$30^{\text{in}}.066$	25°	$30^{\text{in}}.084$	26°	.074	33	.104	30.5	.132	33
28	...	...	...	...	...	...	.202	47	.206	17	.206	17
29	...	...	...	...	...	...	.308	45	.246	45	.186	15
30	...	...	...	...	...	...	29.930	30.5	29.924	43	29.912	51
Mean,							30.086	28.4	30.088	29.2	30.083	30.0

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait
November, 1860.

Day of the month.	2h		4		6		8		10		Midnight.	
1	29in.576	25°	29in.582	23°	29in.610	23°	29in.628	20°	29in.636	20	...	.
2	.818	25	.876	24	.950	28	.962	27	.86	25	...	.
3	30.036	23	30.038	23	30.046	23	30.056	23	30 046	23	...	.
4	.124	23	124	25	.124	28	.106	28	.106	28	...	.
5	.232	28	.238	28	.242	25	.258	23	.258	23	...	.
6	.058	20	.032	20	.000	18	.000	18	29 984	18	...	..
7	29 772	16	29.772	14	29 772	12	29 750	10	.762	12	...	.
8	30.188	35	30.186	35	30.158	35	30.064	35	30 000	35	...	.
9	29.950	38	29.956	38	.100	39	.154	39	.196	39	...	..
10	30.638	35	30.652	35	.692	35	.698	35	.750	34	...	.
11	.722	40	.718	41	.708	41	.674	41	.628	38	...	.
12	.474	35	.470	35	.452	35	.428	35	.414	34	...	.
13	.310	36	.308	37	.302	39	.300	39	.246	40	.	
14	090	25	.092	25	098	24	.074	23	.056	23	..	
15	29.928	26	29.914	23	29.878	23	29.870	20	29.822	17	.	
16	.694	21	.682	21	.658	20	.650	20	.600	18	.	
17	.750	28	.764	26	.800	29	.800	29	.800	30	.	..
18	.900	32	.852	25	.858	25	.870	25	872	25	...	.
19	.824	29	.812	25	.800	23	.818	23	.824	22	...	.
20	.912	23	.918	25	.922	27	.952	27	982	26	...	..
21	30.192	32	30.190	32	30.184	32	30.180	30	30 058	28	...	...
22	29.812	25	29.850	25	29.838	25	29.824	25	29 822	26	...	...
23	30.000	30	30.024	31	30.038	30	30.024	30	30 000	27	...	...
24	.154	35	.176	35	.222	35	.312	32	.374	31	...	..
25	.730	37	.724	35	.744	35	.752	35	.600	35	...	..
26	.156	29	.324	34	.356	32	.276	29	.200	27	30in.154	24
27	.172	37	.172	40	.200	40	.200	40	.182	37	...	...
28	.212	47	.212	42	.236	42	.236	42	.250	42	...	...
29	.132	44	.132	44	.076	41	.002	39	29.958	26	...	...
30	29.980	52	29.978	50	29.976	49	29.978	42	30.505?	46	...	...
Means	30.095	31.0	30.093	30.5	30.101	30.4	30.096	29.5	30.094	2		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait.
December, 1860.

Day of the month.	2h		4		6		8		10		Noon	
1	---	---	---	---	---	---	30^{in}.[illegible]6	40°	30^{in}.297	45°	30^{in}.299	42°
2	---	---	---	---	---	---	.487	39	.474	39	.472	39
3	---	---	---	---	---	---	.162	37	.106	38	.062	40
4	29^{in}.865	33°	29^{in}.838	30°	29^{in}.836	30°	29.824	33	29.785	35	29.745	34
5	---	---	---	---	---	---	.711	34	.712	34	.714	36.5
6	---	---	---	---	---	---	.810	30	.778	30	.786	29
7	---	---	---	---	--	---	.704	16	.774	19	.774	18
8	---	---	---	---	---	---	.783	37	.802	30	.806	29
9	---	---	---	---	---	---	.704	15	.711	16	.718	17
10	---	---	---	---	---	---	.676	0	.674	−1	.744	76[1]
11	---	---	---	---	---	---	.863	72	.896	76	.963	71
12	---	---	---	---	---	---	30.298	61	30.250	60	30.274	68
13	30.368	68	30.317	58	30.268	52	.321	68.5	.257	71	.229	80
14	---	---	---	---	---	---	.000	62	.016	73	.038	73
15	---	---	---	---	---	---	29.889	64	29.871	67	29.815	64
16	---	---	---	---	---	---	.676	68	.612	68	.546	68
17	---	---	---	---	---	---	.727	72	.749	67	.752	64
18	---	---	---	---	---	---	30.145	60	30.133	63	30.038	67
19	30.059	55	30.073	55	30.132	61	.192	63	.168	60	.162	60
20	---	---	---	---	---	---	.311	73	.303	58	.386	61
21	---	---	---	---	---	---	.735	65	.702	60	.672	62
22	---	---	---	---	---	---	.599	69	.634	61	.691	70
23	---	- - -	---	---	---	---	.424	60	.400	61	.352	61
24	---	---	---	---	---	---	.456	56	.450	57	.552	68
25	30.677	53	30.706	52	30.718	49	.740	64	.772	69.5	.786	70
26	---	---	---	---	---	---	.642	64.5	.488	67	.493	66
27	---	---	---	---	---	---	.413	81	.392	70	.390	62.5
28	---	---	---	---	---	---	.354	54	.364	71	.373	74
29	---	---	---	---	---	---	.140	63	.082	57.5	.098	80
30	---	---	---	---	---	---	29.749	72	29.726	67	29.750	73
31	---	---	---	---	---	---	.910	63	.872	57	.818	60
Means							30.118	53.4	30.105	53.1	30.106	57.5

[1] Barometer brought below and hung in the companion-way.

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait.
December, 1860.

Day of the month.	2h		4		6		8		10		Midnight.	
1	30in.312	42°	30in.324	42°	30in.346	42°	30in.352	42°	30in.368	42°	- - -	- - -
2	.456	40	.432	38	.453	41	.416	38	.360	37	- - -	- - -
3	.078	40	.065	40	.008	38	29.986	37	29.945	36	29in.895	34
4	29.736	34	29.728	34	29.742	35	.722	31	.722	31	- - -	- - -
5	.718	37	.724	43	.749	40	.752	40	.762	36	- - -	- - -
6	.795	28	.776	28	.748	28	.750	25	.758	20	- - -	- - -
7	.756	18	.750	15	.748	15	.732	15	.720	14	- - -	- - -
8	.844	28	.810	22	.812	21	.772	19	.750	15	- - -	- - -
9	.685	13	.685	13	.760	15	.742	15	.715	14	- - -	- - -
10	.817	76	.837	72	.836	72	.817	72	.874	74	- - -	- - -
11	30.010	74	30.070	62	30.092	62	30.128	63	30.137	64	- - -	- - -
12	.320	70	.320	64	.398	71	.364	69	.386	66	30.387	74
13	.169	71	.124	60	.100	64	.056	65	.012	68	- - -	- - -
14	.040	69	.070	73	.057	69	.035	68	.023	67	- - -	- - -
15	29.882	65	29.902	71	29.882	69	29.864	66	29.830	64	- - -	- - -
16	.469	68	.321	64	.265	60	.266	61	.261	63	- - -	- - -
17	.806	70	.852	65	.894	61	.946	64	30.063	69	- - -	- - -
18	30.096	79	30.106	72	30.064	64	30.006	61	29.999	59	30.057	57
19	.143	65	.163	79	.104	73	.088	68	30.199	70.5	- - -	- - -
20	.588	62	.622	73	.684	72	.724	69	.757	66	- - -	- - -
21	.613	61	.558	55	.549	61	.563	66	.566	69	- - -	- - -
22	.684	67	.682	61	.676	56	.682	65	.652	62	- - -	- - -
23	.270	57	.241	56	.212	55.5	.183	55	.154	54	- - -	- - -
24	.565	70	.614	66	.648	58	.712	64	.676	58	30.694	55
25	.806	71	.800	70	.819	71	.773	70	.796	62	- - -	- - -
26	.500	67	.476	69	.452	65	.406	61.5	.334	62	- - -	- - -
27	.413	81	.423	71	.443	76	.338	67	.400	72.5	- - -	- - -
28	.414	72	.398	63.5	.372	66	.350	64.5	.322	63	- - -	- - -
29	.018	72	.081	71	29.985	69	29.916	67	29.858	63	- - -	- - -
30	29.762	79.5	29.740	66.5	.750	68.5	.756	65	.772	64.5	- - -	- - -
31	.846	74	.762	70	.740	64	.668	63	.644	67	29.550	59
Means	30.116	58.7	30.111	56.4	30.109	55.6	30.092	54.7	30.091	54.0		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait.
January, 1861.

Day of the month.	2h		4		6		8		10		Noon	
1	29in.522	60°.5	29in.513	64°	29in.516	67°	29in.556	63°	29in.549	61°	29in.563	67°
2	---	---	---	---	---	---	---	---	.486	67	.550	60
3	---	---	---	---	---	---	.508	68	.530	73	.601	72
4	---	---	---	---	---	---	.780	70	.792	64	.800	56
5	---	---	---	---	---	---	30.085	72	30.046	66	30.013	73
6	---	---	---	---	---	---	29.970	70.5	29.974	72	29.962	59.5
7	---	---	---	---	---	---	.624	70	.688	67	.580	54
8	29.950	63	30.064	65	30.066	63.5	30.142	71	30.186	76	30.232	67
9	---	---	---	---	---	---	29.910	62	29.945	76	29.898	75
10	---	---	---	---	---	---	.716	64	.730	74	.770	71
11	---	---	---	---	---	---	30.356	72	30.390	75	30.420	72
12	---	---	---	---	---	---	.288	68	.108	67	29.982	69
13	---	---	---	---	---	---	29.488	74	29.348	65	.292	60
14	---	---	---	---	---	---	.516	65	.550	73.5	.568	65
15	29.504	57	29.550	54	29.500	51	.542	64	.593	65	.606	69
16	---	---	---	---	---	---	30.116	71	30.216	83.5	30.234	76
17	---	---	---	---	---	---	.548	69	.500	68	.532	66
18	---	---	---	---	---	---	.384	70	.372	67	.338	65.5
19	---	---	---	---	---	---	.318	67	.310	77	.306	76
20	---	---	---	---	---	---	.174	66	.130	68.5	.114	68
21	---	---	---	---	---	---	29.950	73	29.956	72	29.950	68
22	30.144	53	30.112	52.5	30.112	46	30.122	60	30.172	63	30.182	61
23	---	---	---	---	---	---	.124	70	.102	80	.066	65
24	---	---	---	---	---	---	29.934	59	29.988	73	29.980	70
25	---	---	---	---	---	---	.836	59.5	.756	64.5	.708	60
26	---	---	---	---	---	---	.734	78	.698	67	.681	69
27	---	---	---	---	---	---	.908	71	.900	57.5	.940	73
28	---	---	---	---	---	---	30.078	65	30.056	69	30.084	81
29	29.892	65	29.880	58.5	29.938	62	29.964	63.5	.028	88	.018	80
30	---	---	---	---	---	---	.882	59	29.886	70	29.908	83
31	---	---	---	---	---	---	30.072	73	30.092	79	30.126	87
Means							29.939	67.3	29.938	70.6	29.936	69.0

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait. January, 1861.

Day of the month.	2^h		4		6		8		10		Midnight	
1	$29.^{in}606$	74°	$29^{in}.601$	71°	$29^{in}.624$	66°	$29^{in}.536$	66.°5	- - -	- - -	- - -	- - -
2	.443	65	.438	70	.412	71	.436	68	$29^{in}.420$	68°	- - -	- - -
3	.572	73.5	.572	65	.590	65	.608	66.5	.610	60	- - -	- - -
4	.878	59.5	.968	62	30.012	65	30.028	68	30.054	71	- - -	- - -
5	.976	70	.956	75	29.900	74	29.890	74.5	29.868	66	- - -	- - -
6	.984	72	.965	79	.973	71	.968	70	.924	68	- - -	- - -
7	.620	70	.632	87	.666	76	.700	71	.824	71	$29^{in}.886$	76°
8	30.268	74	30.274	74	30.250	68	30.250	74	30.236	75	- - -	- - -
9	29.886	76	29.850	70	29.812	75	29.806	73	29.788	65	- - -	- - -
10	.830	71.5	.988	65	.961	61	30.042	72	30.036	70	- - -	- - -
11	30.450	68	30.472	69	30.516	65.5	.494	65	.472	65.5	- - -	- - -
12	29.946	73	29.848	67	29.778	60	29.718	64	29.700	72	- - -	- - -
13	.266	75	.250	70.5	.268	74	.294	70	.282	67	- - -	- - -
14	.562	62	.606	71	.600	71.5	.620	70	.684	69	29.612	58
15	.748	75	.806	70	.926	73	.954	70	.978	67	- - -	- - -
16	30.256	74	30.300	68	30.345	67	30.382	61	30.424	67	- - -	- - -
17	.550	67	.510	70	.520	71	.500	70	.516	75	- - -	- - -
18	.364	71	.322	67	.318	67	.306	71	.300	69.5	- - -	- - -
19	.284	77	.282	67.5	.292	67	.284	68.5	.320	72	- - -	- - -
20	.124	64	.114	68.5	.082	68.5	.056	69	29.984	63.5	- - -	- - -
21	.025	67	.088	70	.064	66	.064	62	30.076	62	30.076	57.5
22	.170	61.5	.182	69	.182	73.5	.172	70	.164	67	- - -	- - -
23	.092	71	.052	64	.060	66	.040	70	.012	75.5	- - -	- - -
24	29.998	78	.013	76	29.944	72.5	29.944	79	29.950	75	- - -	- - -
25	.722	75	29.774	71	.776	73	.756	73	.758	72	- - -	- - -
26	.726	75	.756	65.5	.622	59	.672	57	.662	73.5	- - -	- - -
27	.994	70	30.012	67	30.028	66	30.038	67	30.076	73	- - -	- - -
28	30.000	68.5	29.992	78	.032	77	29.984	84	29.946	83	29.932	71
29	29.950	68	.962	79	29.944	78	.920	77	.874	72	- - -	- - -
30	.922	66	.909	70	.929	67	30.000	67	.946	67.5	- - -	- - -
31	30.058	69	30.098	83.5	30.084	67	.068	68	30.052	70	- - -	- - -
Means	29.944	70.3	29.956	70.9	29.953	69.1	29.953	69.6	29.951	69.6		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait. February, 1861.

Day of the month.	2h		4		6		8		10		Noon	
1	---	---	---	---	---	---	29^{in}.876	68°	29^{in}.762	64°	29^{in}.640	70°
2	---	---	---	---	---	---	.772	70	.824	75	.831	73
3	---	---	---	---	---	---	30.132	78	30.132	75	30.138	70
4	---	---	---	---	---	---	.118	67	.062	64	29.968	67
5	29^{in}.980	72°	29^{in}.992	65°	29^{in}.974	58°	29.988	64	.026	71	30.052	70
6	---	---	---	---	---	---	.850	74	29.892	78	29.846	69
7	---	---	---	---	---	---	30.030	69	30.048	62	30.014	57
8	---	---	---	---	---	---	29.762	62.5	29.800	70	29.816	71
9	---	---	---	---	---	---	.950	72	.900	73	.782	70
10	---	---	---	---	---	---	.168	75	.100	75	.088	70
11	---	---	---	---	---	---	.630	57.5	.652	60	.648	53
12	29.884	57	29.900	50	30.002	45	30.048	50	30.098	60	30.126	59
13	---	---	---	---	---	---	.296	67	.262	64	.256	66
14	---	---	---	---	---	---	29.850	41.5	29.898	60	29.888	64
15	---	---	---	---	---	---	.924	65	30.000	75	30.020	70
16	---	---	---	---	---	---	.870	45	29.914	53	29.924	66
17	---	---	---	---	---	---	.900	87	.940	65	.922	68
18	---	---	---	---	---	---	.880	62	.958	76	.930	70
19	29.894	61.5	29.850	57	29.808	54	.750	67	.718	66	.700	69.5
20	---	---	---	---	---	---	.640	55.5	.678	69	.708	72
21	---	---	---	---	---	---	.800	69	.824	62	.904	60
22	---	---	---	---	---	---	30.032	60	30.000	56.5	30.018	63
23	---	---	---	---	---	---	.012	62	---	---	.042	72
24	---	---	---	---	---	---	29.878	74.5	29.840	66	29.838	73.5
25	---	---	---	---	---	---	.688	62.5	.668	74.5	.650	74.5
26	---	---	---	---	---	---	.464	49	.526	69	.560	74
27	---	---	---	---	---	---	.632	47	.718	74	.716	71
28	---	---	---	---	---	---	.674	61	.686	68	.624	69.5
Means							29.843	63.6	29.855	67.5	29 844	67.9

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait.
February, 1861.

Day of the month.	2h		4		6		8		10		Midnight.	
1	29in.592	78°	29in.616	81°	29in.624	80°	29in.638	79°	29in.642	71	- - -	- - -
2	.968	78	30.032	73	30.036	71.5	30.042	71	30.036	72	- - -	- - -
3	30.130	67	.126	61.5	.160	73	.150	72	.186	67	- - -	- - -
4	29.992	75	.018	88	29.972	79	29.968	80	29.900	78	29in.926	78
5	30.078	65	.094	69	30.078	80	30.092	76	.978	95	- - -	- - -
6	29.824	76	29.838	79.5	29.828	77.5	29.822	76	.856	78	- - -	- - -
7	30.024	62	30.032	83	30.012	55	30.062	69	30.008	71	- - -	- - -
8	29.866	73	29.900	71	29.912	61	29.974	65	.018	72	- - -	- - -
9	.656	66	.556	61	.458	71	.512	76	29.458	72	- - -	- - -
10	.134	75	.212	74	.450	69	.442	68	.438	67	- - -	- - -
11	.728	59	.782	72.5	.864	65	.924	64	.916	64.5	29.952	62.5
12	30.140	54	30.246	60	30.288	68	30.292	70	30.304	65	- - -	- - -
13	.168	69	.204	69	.178	72	.154	88	.074	76	- - -	- - -
14	29.848	55	29.848	58	29.896	78	29.900	75	29.912	73	- - -	- - -
15	30.000	65	- - -	- - -	30.064	72	30.050	66	30.048	70	- - -	- - -
16	29.914	73	.860	68	29.868	67	29.850	62	29.832	67	- - -	- - -
17	.918	71	.962	78	.930	78	.939	78	.926	73	- - -	- - -
18	30.000	77.5	.984	69	30.028	74.5	30.000	70.5	30.100	72	29.956	66
19	29.708	80.5	.686	80	29.680	75	29.692	75.5	29.676	70.5	- - -	- - -
20	.688	69	- - -	- - -	.689	69	.730	66	.762	72.5	- - -	- - -
21	.850	60	.884	75	.912	65	.924	65	.988	75	- - -	- - -
22	30.037	72	30.054	75	30.052	78	30.038	70	30.060	64	- - -	- - -
23	.030	72	.000	72	.020	75	.008	75.5	29.988	71.5	- - -	- - -
24	29.818	69	29.838	65	29.800	69	29.776	51	.796	62	- - -	- - -
25	.636	69	.612	69	.662	83	.628	78	.596	67	- - -	- - -
26	.512	74	.518	87	.538	74	.538	70	.512	74	- - -	- - -
27	.700	67	.726	69	.750	71	.762	75	.746	69	- - -	- - -
28	.636	78	.620	64	.700	86	.638	70	.658	69.5	- - -	- - -
Means	29.843	69.6	29.856	71.7	29.873	72.7	29.877	71.5	29.872	71.0		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait
March, 1861.

Day of the month.	2^h		4		6		8		10		Noon	
1	- - -	- - -	- - -	- - -	- - -	- - -	29in.626	57°.5	29in.678	64°	29in.734	76°
2	- - -	- - -	- - -	- - -	- - -	- - -	.638	56	.692	64.5	.694	66.5
3	- - -	- - -	- - -	- - -	- - -	- - -	.706	55	.792	75	.808	79
4	- - -	- - -	- - -	- - -	- - -	- - -	.644	63 5	.640	64	.674	65.5
5	29in.588	51°.5	29in.568	47°	29in.504	42°	.508	45	.480	59	.438	58
6	- - -	- - -	- - -	- - -	- - -	- - -	.386	58	- - -	- - -	.434	62.5
7	- - -	- - -	- - -	- - -	- - -	- - -	.476	56.5	.514	69	.520	71
8	- - -	- - -	- - -	- - -	- - -	- - -	.500	60	.480	62.5	.520	68 5
9	- - -	- - -	- - -	- - -	- - -	- - -	.698	62	.684	65	.652	66.5
10	- - -	- - -	- - -	- - -	- - -	- - -	.538	60.5	.644	79	.704	79
11	- - -	- - -	- - -	- - -	- - -	- - -	.870	61	.790	60.5	.794	74
12	- - -	- - -	- - -	- - -	- - -	- - -	30.064	55	30.094	72	30.074	67
13	- - -	- - -	- - -	- - -	- - -	- - -	29.862	71	29.860	78	29.874	76
14	- - -	- - -	- - -	- - -	- - -	- - -	.948	59	.924	76	.900	72
15	- - -	- - -	- - -	- - -	- - -	- - -	.792	52	.814	57	.880	79
16	- - -	- - -	- - -	- - -	- - -	- - -	30.126	46.5	30.146	61	30.148	69.5
17	- - -	- - -	- - -	- - -	- - -	- - -	.000	57	.014	65	29.986	63
18	- - -	- - -	- - -	- - -	- - -	- - -	29.672	56	29.604	49	.632	57
19	- - -	- - -	- - -	- - -	- - -	- - -	30.008	46	30.032	56.5	30.056	59
20	- - -	- - -	- - -	- - -	- - -	- - -	29.918	43	29.948	61	.024	78
21	- - -	- - -	- - -	- - -	- - -	- - -	30.112	60	30.124	64	.166	69
22	- - -	- - -	- - -	- - -	- - -	- - -	.034	49.5	.082	68	.128	74
23	- - -	- - -	- - -	- - -	- - -	- - -	.266	56	.302	62	.416	69.5
24	- - -	- - -	- - -	- - -	- - -	- - -	.122	49	.106	57	.138	66
25	- - -	- - -	- - -	- - -	- - -	- - -	.400	51.5	.446	64	.442	59
26	- - -	- - -	- - -	- - -	- - -	- - -	.318	67	.232	61	.230	69.5
27	- - -	- - -	- - -	- - -	- - -	- - -	29.808	54.5	29.818	57	29.766	67
28	- - -	- - -	- - -	- - -	- - -	- - -	30.310	76	30.340	65	30.428	74
29	- - -	- - -	- - -	- - -	- - -	- - -	.568	60	.560	70.5	.500	73.5
30	- - -	- - -	- - -	- - -	- - -	- - -	29.850	66	29.806	65	29.808	69.5
31	- - -	- - -	- - -	- - -	- - -	- - -	.864	56	.950	73	.962	72
Means							29.891	57.0	29.903	64 7	29.920	69.4

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait
March, 1861.

Day of the month.	2h		4		6		8		10		Midnight.	
1	29in.652	60°	29in.686	72°	29in.680	72°	29in.676	72°	29in.660	71.5	- - -	- - -
2	.764	68	.732	70	.736	71	.714	69	.720	69	- - -	- - -
3	.772	72.5	.760	72	.760	68	.762	75.5	.730	68	- - -	- - -
4	.686	73	.712	70	.828	74	.692	72	.686	71.5	29in.650	65.5
5	.419	70	.428	74	.398	69	.352	61	.342	69	- - -	- - -
6	.462	64.5	.466	63	.522	73	.514	67	.506	67	- - -	- - -
7	.528	79	.576	71	.572	79	.628	83	.600	78	- - -	- - -
8	.522	71	.514	71.5	.618	69	.672	67.5	.712	70	- - -	- - -
9	.618	71.5	.592	77	.576	72	.564	76	.506	73.5	- - -	- - -
10	.764	75	.864	77	.988	80	30.014	79	30.006	68	- - -	- - -
11	.796	73.5	.854	70	.910	61.5	29.918	59	.014	64	- - -	- - -
12	30.030	62	30.062	68	30.046	73	30.042	73	.002	68.5	- -	- - -
13	29.848	69	29.884	61	29.914	72	29.954	72	29.958	74.5	- - -	- - -
14	.954	75	.870	67	.902	71.5	.868	70.5	.838	65	- - -	- - -
15	.850	56	- - -	- - -	30.000	65	30.072	68	30.072	66.5	- - -	- - -
16	30.042	67	30.042	67	.028	69.5	29.988	72	29.994	74.5	- - -	- - -
17	.004	71.5	29.892	66	.002	70	.962	65.5	.974	65	- - -	- - -
18	29.608	55	.604	56	29.738	63	.788	65.5	.832	64.8	- - -	- - -
19	30.009	67	30.010	70	30.052	69.5	30.076	62	30.002	60.5	- - -	- - -
20	.012	71.5	.014	57.5	.042	56	.072	67.5	.012	67	- - -	- - -
21	.160	69.5	.134	63.5	.124	72	.108	69.5	.074	61	- - -	- - -
22	.154	66	.178	68	.234	67	.254	74	.242	70	- - -	- - -
23	.304	67	.284	63	.294	74.5	.268	69.5	.272	64	- - -	- - -
24	.150	64	.154	67.5	.168	68	.204	69	.244	71	- - -	- - -
25	.484	70	.514	58	- - -	- - -	.492	69.5	.462	69	- - -	- - -
26	.196	68	.168	66	.146	64	.138	75	.100	79.5	- - -	- - -
27	29.818	72	29.794	58	29.800	59	29.858	66	29.886	62.5	- - -	- - -
28	30.462	76	30.514	75	30.522	60.5	30.548	60	30.648	74	- - -	- - -
29	.462	74	.365	72	.304	70	.184	63	.158	65.5	- - -	- - -
30	29.780	70	29.818	60	29.842	77	29.844	67	29.834	66	- - -	- - -
31	.934	66	.926	55.5	.976	69	30.000	75	.978	68	- - -	- - -
Means	29.909	68.9	29.914	66.8	29.943	69.1	29.943	69.5	29.938	68.6		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait.
April, 1861.

Day of the month.	2^h		4		6		8		10		Noon.	
1	- - -	- - -	- - -	- - -	- - -	- - -	29in.770	55°	29in.798	63°.5	29in.844	72°
2	- - -	- - -	- - -	- - -	- - -	- - -	30.200	61	30.322	69	30.332	66
3	- - -	- - -	- - -	- - -	- - -	- - -	.294	60	.256	66	.238	72
4	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	.466	53.5	.564	59.5
5	- - -	- - -	- - -	- - -	- - -	- - -	.798	82	.758	70	.724	64
6	- - -	- - -	- - -	- - -	- - -	- - -	.494	68	.488	67	.488	67
7	- - -	- - -	- - -	- - -	- - -	- - -	.520	65	.558	76.5	.554	71
8	- - -	- - -	- - -	- - -	- - -	- - -	.312	67	.236	65.5	.222	63
9	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	.284	69.5	.260	57
10	- - -	- - -	- - -	- - -	- - -	- - -	.138	61	.130	61	.136	51.5
1	- - -	- - -	- - -	- - -	- - -	- - -	.378	69	- - -	- - -	.180	50
12	- - -	- - -	- - -	- - -	- - -	- - -	29.847	57	29.880	65	29.908	66
13	- - -	- - -	- - -	- - -	- - -	- - -	.832	58	.880	65	.920	76
14	- - -	- - -	- - -	- - -	- - -	- - -	30.054	63	30.052	63	30.070	61
15	- - -	- - -	- - -	- - -	- - -	- - -	.208	60	- - -	- - -	.212	56.5
16	- - -	- - -	- - -	- - -	- - -	- - -	.150	63	.144	62	.140	56
17	- - -	- - -	- - -	- - -	- - -	- - -	29.880	65	29.850	60	- - -	- - -
18	- - -	- - -	- - -	- - -	- - -	- - -	30.222	52.5	30.212	60	.196	60
19	- - -	- - -	- - -	- - -	- - -	- - -	29.946	66.5	29.910	60.5	29.852	64
20	- - -	- - -	- - -	- - -	- - -	- - -	.542	67	.538	68	.592	69
21	- - -	- - -	- - -	- - -	- - -	- - -	.824	73	.828	60	.842	53
22	- - -	- - -	- - -	- - -	- - -	- - -	30.208	56	30.206	64	30.130	58
23	- - -	- - -	- - -	- - -	- - -	- - -	29.778	56	29.796	56.5	29.830	58
24	- - -	- - -	- - -	- - -	- - -	- - -	.992	50	30.000	57	30.068	73
25	- - -	- - -	- - -	- - -	- - -	- - -	.940	60	29.890	58.5	29.888	51
26	- - -	- - -	- - -	- - -	- - -	- - -	30.232	54	30.228	60	30.222	64
27	- - -	- - -	- - -	- - -	- - -	- - -	.268	65.5	.275	70	.292	69
28	- - -	- - -	- - -	- - -	- - -	- - -	.488	68	.444	62.5	.452	65
29	- - -	- - -	- - -	- - -	- - -	- - -	.400	70	.352	65.5	.342	60
30	- - -	- - -	- - -	- - -	- - -	- - -	.092	55	.100	65	.062	68
Means							30.150	62.3	30.145	63.4	30.118	62.8

Readings of the barometer and attached thermometer near and at Port Foulke, Smith Strait.
April 1861.

Day of the month.	2h		4		6		8		10		Midnight.	
1	$29^{\text{in}}.838$	63°	$29^{\text{in}}.890$	68°	$29^{\text{in}}.940$	71°.5	$29^{\text{in}}.976$	68°	$30^{\text{in}}.006$	73°	- - -	- - -
2	30.346	56	30.352	58	30.338	46	30.382	59	.398	69	- - -	- - -
3	.214	77	.196	66	.212	69	.196	66	.200	64.5	- - -	- - -
4	.592	60	- - -	- - -	.684	61.5	.680	52.5	.624	51	- - -	- - -
5	.708	68	- - -	- - -	.654	60	.616	56.5	.564	49	- - -	- - -
6	.480	68	.490	66.5	.502	68	.538	70	- - -	- - -	- - -	- - -
7	.550	67	- - -	- - -	.530	66.5	.508	63	.444	53	- - -	- - -
8	.188	68	.198	53	.202	54	- - -	- - -	.224	51.5	- - -	- - -
9	.248	51.5	.264	57	.260	57	- - -	- - -	.182	51	- - -	- - -
10	- - -	- - -	- - -	- - -	.258	60	.300	64	.344	66	- - -	- - -
11	.100	55.5	- - -	- - -	29.964	67	29.910	62	29.900	61	- - -	- - -
12	29.842	56	29.886	49.5	.900	48	.920	63	.900	60	- - -	- - -
13	.902	67 5	.926	53.5	.992	64	.994	63	30.000	58	- - -	- - -
14	30.096	70	30.124	72	30.138	73	30.142	70	- - -	- - -	- - -	- - -
15	.192	55	- - -	- - -	- - -	- - -	- - -	- - -	.116	46	- - -	- - -
16	.100	47	.092	- - -	.086	60	- - -	- - -	- - -	- - -	- - -	- - -
17	29.946	64	.086	68.5	.234	66.5	.284	58.5	.340	64	- - -	- - -
18	30.194	59	- - -	- - -	.132	63	- - -	- - -	.100	65	- - -	- - -
19	29.692	66	29.624	48	29.600	50	29.592	62	29.570	65.5	- - -	- - -
20	.596	68.5	.600	67	.594	57	.584	57.5	- - -	- - -	- - -	- - -
21	.948	67	.992	67	30.080	67	30.144	66	30.192	61	- - -	- - -
22	30.126	58	30.100	60	.040	66	.004	64	29.992	60	- - -	- - -
23	29.890	64	29.872	57	29.908	57	29.908	53	.900	52	- - -	- - -
24	30.068	62.5	30.050	60	30 038	60	30.036	59.5	30.022	56	- - -	- - -
25	29.896	50	29.908	48.5	29.942	48	.000	55	.078	56	- - -	- - -
26	30.188	54	30.174	55	30.194	60	.208	56.5	.252	54	- - -	- - -
27	.272	62	.274	65	.290	52	.348	55.5	.356	60	- - -	- - -
28	.432	61	.432	61	.444	56	.450	65	- - -	- - -	- - -	- - -
29	.324	62	.294	58	.232	52	.234	63	.224	64.5	- - -	- - -
30	.024	63	29.974	56	29.926	52	29.986	68	.060	63	- - -	- - -
Means	30.139	61.5	30.141	59.7	30.149	59.4	30.156	60.7	30.158	59.9		

Readings of the barometer and attached thermometer near and at Port Foulke, Smith Strait. May, 1861.

Day of the month.	2h		4		6		8		10		Noon.	
1	- - -	- - -	- - -	- - -	- - -	- - -	29in.938	60°	- - -	- - -	29in.968	60°
2	- - -	- - -	- - -	- - -	- - -	- - -	30.018	76	29in.912	68°	.856	69
3	- - -	- - -	- - -	- - -	- - -	- - -	.188	55	30.096	50.5	30.068	48
4	- - -	- - -	- - -	- - -	- - -	- - -	.272	58	.324	64	.362	65
5	- - -	- - -	- - -	- - -	- - -	- - -	.636	50	.638	52	.662	67
6	- - -	- - -	- - -	- - -	- - -	- - -	.394	62.5	.386	60	.374	58.5
7	- - -	- - -	- - -	- - -	- - -	- - -	.484	49	.508	55	.492	53
8	- - -	- - -	- - -	- - -	- - -	- - -	.352	61.5	.398	65.5	.362	65
9	- - -	- - -	- - -	- - -	- - -	- - -	.444	49	.432	49	.428	56
10	- - -	- - -	- - -	- - -	- - -	- - -	.232	43	.208	44	.202	52.5
11	- - -	- - -	- - -	- - -	- - -	- - -	.268	65	.278	67.5	.252	72
12	- - -	- - -	- - -	- - -	- - -	- - -	.110	58.5	.122	71.5	.132	73
13	- - -	- - -	- - -	- - -	- - -	- - -	.268	55	.280	51.5	.294	51.5
14	- - -	- - -	- - -	- - -	- - -	- - -	.348	56	.320	60	.346	67
15	- - -	- - -	- - -	- - -	- - -	- - -	.230	51	.250	66	.246	61.5
16	- - -	- - -	- - -	- - -	- - -	- - -	.366	49	.348	53	.352	55
17	- - -	- - -	- - -	- - -	- - -	- - -	.022	47	29.976	51	29.900	51
18	- - -	- - -	- - -	- - -	- - -	- - -	29.964	42	.954	45	.964	53
19	- - -	- - -	- - -	- - -	- - -	- - -	.888	58	.868	58	.884	74
20	- - -	- - -	- - -	- - -	- - -	- - -	.726	49	.750	69	.746	69.5
21	- - -	- - -	- - -	- - -	- - -	- - -	.668	49	.732	61	.734	52.5
22	- - -	- - -	- - -	- - -	- - -	- - -	30.038	51.5	30.068	60	30.068	58
23	- - -	- - -	- - -	- - -	- - -	- - -	.006	57	- - -	- - -	29.970	45
24	- - -	- - -	- - -	- - -	- - -	- - -	29.876	50	29.860	55	.866	53
25	- - -	- - -	- - -	- - -	- - -	- - -	.926	57.5	.894	55	.906	53
26	- - -	- - -	- - -	- - -	- - -	- - -	.900	52	.816	53	- - -	- - -
27	- - -	- - -	- - -	- - -	- - -	- - -	.688	56	.656	60.5	.642	59
28	- - -	- - -	- - -	- - -	- - -	- - -	.644	58	.692	58.5	.792	58
29	- - -	- - -	- - -	- - -	- - -	- - -	.736	48	.710	49	.742	55.5
30	- - -	- - -	- - -	- - -	- - -	- - -	.800	58	.782	50	.766	50
31	- - -	- - -	- - -	- - -	- - -	- - -	.718	43.5	.712	45	.762	63.5
Means							30.068	54.0	30.062	56.8	30.064	58.8

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait
May, 1861.

Day of the month.	2h		4		6		8		10		Midnight.	
1	29in.922	52°	29in.904	52°	29in.942	44°	29in.986	59°	30in.020	63°	. . .	. . .
2	.800	70	.798	62	.786	55	.876	51	.008	67	. . .	. . .
3	30.066	66	30.072	68	30.082	64	. . .	. . .	.180	65	. . .	. . .
4	.412	64	.448	63	.464	71	30.522	67	.546	61.5	. . .	. . .
5	. . .	. . .	.614	64	.600	60	.580	62	.542	64	. . .	. . .
6	.418	60	.428	67	.438	66	.456	68	.472	68	. . .	. . .
7	.474	55	.474	63	.476	66.5	.432	67	.414	68.5	. . .	. . .
8	.374	65	.418	65	.428	66	.450	62	.452	65	. . .	. . .
9	.416	49.5	.424	49.5	.398	48	.372	50	.362	55	. . .	. . .
10	.250	68	.232	71	.234	71.5	.220	66	.224	66	. . .	. . .
11	.248	65	.240	66	.212	59.5	.200	62	.190	64	. . .	. . .
12	.164	74	.176	69	.194	70	.204	63.5	.218	63	. . .	. . .
13	.292	50	. . .	. . .	.340	53	.376	55	. . .	. . .	. . .	. . .
14	.300	61	.274	63.5	.272	63	.246	63	.264	65	. . .	. . .
15	.252	67	.266	65	.284	66	.318	69	.336	66	. . .	. . .
16	.356	54.5	.322	57	.308	59	.270	54	.238	57	. . .	. . .
17	29.924	48	29.938	55	29.948	60	29.950	53	29.966	55	. . .	. . .
18	.988	64	.986	60.5	.962	59.5	.932	64	.940	71	. . .	. . .
19	.842	57	.828	65.5	.844	64	.812	65.5	.812	64	. . .	. . .
20	.742	68	.716	66	.728	64	.674	73	.664	66	. . .	. . .
21	.748	50	.814	54	.874	61	.928	63.5	.958	62.5	. . .	. . .
22	30.066	52	30.074	48	30.068	53	30.058	61	30.048	56	. . .	. . .
23	29.936	50.5	.010	70	29.972	71.5	29.968	72	29.954	70	. . .	. . .
24	.882	58	29.88[illegible]	[illegible]	.886	53	.906	61.5	.896	54	. . .	. . .
25	.880	49.5	.9[illegible]		.924	56	.936	62	.928	63	. . .	. . .
26	.866	51	.886	50.5	.854	50	.796	50.5	.780	49	. . .	. . .
27	.606	56.5	.560	46.5	.554	48.5	.560	48	.566	51.5	. . .	. . .
28	.786	58	.814	55	.812	52	.808	52	.780	57.5	. . .	. . .
29	.742	57.5	.712	54	.720	50.5	.728	50.5	.720	50.5	. . .	. . .
30	.772	52	.788	59	.776	56	.766	53	.770	55	. . .	. . .
31	.736	53.5	.754	54.5	.754	55	.750	55.5	.774	55	. . .	. . .
Means	30.061	58.4	30.069	59.8	30.069	59.2	30.071	[illegible]	30.077	61.2		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait.
June, 1861.

Day of the month.	2h		4		6		8		10		Noon.	
1	...	...	...	...	...	...	29in.738	49°	29in.706	45°	29in.692	45°
2	...	...	...	...	...	...	.640	50	.638	52.5	.636	52
3	...	...	...	...	...	...	.592	52	.582	55	.578	56
4	...	...	...	...	...	...	.684	55	.708	57	.710	59
5	...	...	...	...	...	...	.688	47	.684	46	.694	47
6	...	...	...	...	...	...	.560	46	.508	43.5	.500	45
7	...	...	...	...	...	...	.678	51	.698	58	.670	58
8	...	...	...	...	...	...	.748	53	.712	41	.672	41
9	...	...	...	...	...	...	.608	45.5	.642	65	.638	65
10	...	...	...	...	...	...	.626	46	...	...	.584	50
11	...	...	...	...	...	...	.748	53.5	.734	49	.728	49
12	...	...	...	...	...	...	.860	48	.900	54	.916	55
13	...	...	...	...	...	...	.956	62	.938	53	.944	51
14	...	...	...	...	...	...	.999	46	.930	50	.932	49
15	...	...	...	...	...	...	30.056	61	...	...	...	...
16	...	...	...	...	...	...	29.816	59	.814	62	.782	61
17	...	...	...	...	...	...	30.020	57	30.032	55	30.048	53
18	...	...	...	...	...	...	.006	54	.002	63.5	.004	63.5
19	...	...	...	...	...	...	29.740	47.5	29.700	53.5	29.778	49
20	...	...	...	...	...	...	.844	53	.921	52	.890	49
21	...	...	...	...	...	...	30.024	55	30.032	56	30.022	57
22	...	...	...	...	...	...	29.966	51	29.948	56	29.932	53
23	...	...	...	...	...	...	.898	54.5	.888	54	.884	55
24	...	...	...	...	...	...	.792	53	.734	54	.674	55
25	...	...	...	...	...	...	.584	55	.578	51.5	.534	52
26	...	...	...	...	...	...	.638	50	.654	53	.642	51
27	...	...	...	...	...	...	.559	49	.544	53.5	.546	56
28	...	...	...	...	...	...	.492	52	.500	56	.518	55.5
29	...	...	...	...	...	...	.500	50	.510	49	.421	58
30	...	...	...	...	...	...	.486	53	.500	62	.476	60.5
Means							29.751	51.9	29.746	53.5	29.736	53.5

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait June, 1861.

Day of the month.	2h		4		6		8		10		M. In. ht.	
1	29in.692	47	29in.708	53	29in.706	[illegible]	29in.674	54	29in.688	54.5	...	...
2	.632	48.5	.612	48.5	.632	50.5	.632	49.5	.610	50	...	...
3	.616	57	.612	61	.604	56	.584	50	.584	48	...	...
4	.716	55	.730	50	.714	48	...	...	.760	62	...	...
5	.674	50	.688	50	.650	45	.654	49	.650	54	...	...
6	.522	42	.522	48	.540	47	.564	52	.508	50	...	...
7	.738	56	.694	54	.720	45	.734	48	.758	57	...	...
8	.692	48	...	...	.674	50	.692	51	.636	54	...	...
9	.654	56	.612	49.5	.658	49	...	...	.668	50.5	...	...
10	.542	53	.551	51	.578	51	.550	51	.522	57	...	...
11	.726	47	.738	50.5	.786	49	.786	53	.798	50	...	...
12	.960	54	.951	58	.942	[illegible]	30.020	54	...	...	...	...
13	...	...	.916	54	.924	52	29.948	54	.942	51	...	...
14	30.030	49	30.014	54	30.018	55	30.038	60	30.046	58	...	...
15	...	...	.016	50	.002	48	29.934	52	29.960	56	...	...
16	29.795	59	29.828	54	29.888	59	.912	58	...	...	...	...
17	30.026	55	30.004	54	30.036	54	30.023	53	30.044	53	...	...
18	29.986	62	29.946	55.5	29.928	53	29.898	54	29.892	50	...	...
19	.742	51	.779	57	.772	53	.768	51.5	.776	52	...	...
20	.820	51	.990	53	.996	51	...	...	.978	57	...	...
21	30.060	57	30.076	54	30.050	52	30.052	50.5	30.026	55	...	...
22	...	...	20.918	51	29.926	59	29.804	57	29.878	55	...	...
23	29.912	54	.914	54	.906	53	.888	53.5	.892	53	...	...
24	.670	57	.682	57	.674	55	.676	57	.670	54	...	...
25	.586	53	.568	54	.568	54	.594	54	.586	53	...	...
26	.522	54	.542	52	.632	54	.640	57	.614	56	...	...
27	.564	56.5	.544	57	.556	57	.546	56.5	.534	55.5	...	...
28	.516	58	.510	57.5	.524	55	.510	53.5	.502	52	...	...
29	.456	59	.443	55	.444	54	.404	61.5	.448	59	...	...
30	.466	59	.468	55	.492	61	.494	60.5	.472	58	...	...
Means	29.740	53.5	29.743	53.6	29.750	52.6	29.748	53.7	29.747	54.2		

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait. July, 1861.

Day of the month.	2h		4		6		8		10		Noon.	
1	---	---	---	---	---	---	29in.400	55°	29in.420	59°	9in.374	56°
2	---	---	---	---	---	---	.504	57	.492	56	.466	57
3	---	---	---	---	---	---	.450	59	.484	57	.504	56.5
4	---	---	---	---	---	---	.716	55	---	---	.744	56
5	---	---	---	---	---	---	.708	50	---	---	.706	57
6	---	---	---	---	---	---	.356	48	.376	50.5	.440	54
7	---	---	---	---	---	---	.646	55.5	.640	56	.654	58
8	---	---	---	---	---	---	.682	57	.758	60	.816	61
9	---	---	---	---	---	---	30.038	56	.984	58	---	---
10	---	---	---	---	---	---	29.763	55	.692	54	.646	60
11	---	---	---	---	---	---	.900	56	.964	57.5	.932	60
12	---	---	---	---	---	---	.830	54	.888	59	.730	67
13	---	---	---	---	---	---	.992	57	---	---	30.186	58
14	---	---	---	---	---	---	.950	56	.988	56	29.974	54
15	29in.850	53°	29in.836	52°.5	29in.778	53°	.818	57	.876	56	.956	54
16	30 046	47	.980	47	.984	48	.988	50	30.120	48	30.124	50
17	29.988	50	.994	50	.882	50	.926	50	29.903	50.5	.032	50
18	.870	52	.820	52	.832	50	.792	50	.842	50	29.810	51
19	.770	48	.750	50	.750	50	.650	50	.600	51.5	.630	71.5
20	.712	59	.722	57	.668	57	.658	58.5	.604	59	.618	54
21	.656	53.5	.682	54.5	.628	54.5	.612	55	.684	51	.744	78
22	.594	67	.569	55	.604	49	.612	52	.594	60	.600	75
23	.576	60	.568	56	.500	56	.450	58	.535	69.5	.589	76.5
24	.700	55	.710	54	.664	54	.662	53.5	---	---	.630	66
25	.590	60	.564	56	.622	53	.656	59	.650	73	.630	73
26	.818	67	.810	61	.770	59.5	.800	60.5	.826	69	.868	76
27	.930	56	950	54	.888	53	.894	53	.958	58	.970	58
28	.828	52	.826	51	.812	50	.786	51	.780	52	---	---
29	.826	55	.848	56	.840	53	.850	54	.862	54	.842	54
30	.850	58.5	.870	56	.766	55.5	.836	56	.844	54	.870	56
31	30.028	55	30.025	54	.980	50	.990	52	30.100	53	30.100	56.5
Means							29.739	54.5	29.762	56.8	29.774	60.2

Readings of the barometer and attached thermometer at Port Foulke, Smith Strait July, 1861.

Day of the month.	2^h		4		6		8		10		Midnight.	
1	$29^{in}.364$	58°	$29^{in}.372$	58°	$29^{in}.370$	58°	$29^{in}.342$	56°	$29^{in}.346$	55	- - -	- - -
2	.428	57	.466	55	.452	53	.424	56	.418	58	- - -	- - -
3	.528	58	.570	56	.584	55	.612	62	.608	60	- - -	- - -
4	.776	58	- - -	- - -	.762	56	.820	58	.784	56.5	- - -	- - -
5	.700	58.5	.702	56.5	.656	57	.636	56	.546	53	- - -	- - -
6	.424	54	.498	59.5	.526	58	.516	57	- - -	- - -	- - -	- - -
7	.649	58.5	.644	58	.626	57	.617	56.5	.612	55.5	- - -	- - -
8	.886	63	- - -	- - -	.900	63	.904	58	.904	57	- - -	- - -
9	30.058	61	30.050	59.5	30.038	57	30.034	59	30.062	58	- - -	- - -
10	29.598	58	29.572	58	29.602	57	- - -	- - -	29.652	54	- - -	- - -
11	.928	56	.926	58	.924	58	29.900	57	.820	54	- - -	- - -
12	.776	56	.988	56	.992	58	30.044	60	- - -	- - -	- - -	- - -
13	30.129	57	30.057	57	30.058	57	.056	57	30.052	56	- - -	- - -
14	29.960	54	29.928	54	29.900	55	29.886	55	29.888	55	$29^{in}.884$	53
15	.893	54	.904	53	30.033	46	.950	47	.878	46	.950	45.5
16	.898	49	.985	50	29.878	51	.968	50	30.044	50	.933	52
17	.978	50	.900	45	.942	51	.876	51	29.954	51	.924	48
18	.808	53	.838	51	.855	51	.820	51	.750	45.5	.750	48
19	.673	66	.635	64	.681	84	.618	73	.635	63	.592	62.5
20	.634	54	.618	51	.672	53.5	.642	50	.704	55	.718	53
21	.682	70.5	.640	70	.590	63	.656	70	.608	60	.570	76
22	.563	67	.528	73	- - -	- - -	.500	72	.700	76	.521	72
23	.648	73	.616	77	.650	64	.614	57	.700	55	.700	55
24	- - -	- - -	.650	78	.715	74	.670	65	.650	72.5	.620	73
25	.682	76	.684	79	.788	78	.750	72.5	.756	69.5	.758	84
26	.928	75	.966	72	.880	65	.882	62	.938	61	.936	58
27	.870	54.5	.880	55	.870	55	.930	55	.850	54	.830	54
28	- - -	- - -	- - -	- - -	- - -	- - -	.750	53	.764	55.5	.758	56
29	.894	61	.934	71	.910	72	.848	72.5	.884	65	.868	58
30	.900	54	.900	54	.985	54	.970	50	30.000	50	30.005	53
31	30.054	57	.957	58	30.070	61	.900	56	29.962	52	29.863	51
Means	29.768	59.5	29.772	60.0	29.783	59.6	29.767	58.4	29.776	57.0		

Notes to the preceding Daily Record.

September. To obtain the monthly means for the hours midnight, 2, 4, and 6 A. M., the following process was adopted: The monthly means for the hours 8, 10, noon, 2, 4, 6, 8, 10 P. M., after supplying the few omissions by simple interpolation, were found $=29^{in}.686$ at 32°; for the same hours the mean for the days September 12 to September 30 $=29^{in}.695$ at 32°; hence the correction to the mean for each of the hours midnight, 2, 4, and 6 A. M., $=-0^{in}.009$, which renders the monthly averages for each observing hour strictly comparable. The few omissions in the last nineteen days for the hours from midnight to 6 were previously supplied by simple interpolation.

October. The monthly means for midnight, 2, 4, 6 A. M., were found by the same method as in preceding month; they depend on eight days of observations.

January to June. The occasional blanks in the record were supplied by interpolation.

July. The same principle of interpolation was applied for the hours midnight, 2, 4, 6 A. M., as in preceding September or October.

Resulting monthly averages of bi-hourly observations of the barometer; temperature reduced to 32°.

	2h	4	6	8	10	Noon	2	4	6	8	10	12h
September	29.690	29.681	29.685	29.695	29.679	29.682	29.684	29.689	29.687	29.686	29.685	29.68[illegible]
October	.563	.584	.592	.616	.616	.619	.618	.618	.617	.625	.629	.658
November	---	---	---	30.086	30.086	30.079	30.088	30.087	30.096	30.094	30.094	---
December	---	---	---	.051	.039	.029	.035	.036	.037	.022	.023	---
January	---	---	---	29 835	29.825	29.827	29.832	29.842	29.844	29.843	29.841	---
February	---	---	---	.750	.751	.739	.734	.741	.756	.762	.759	---
March	---	---	---	.816	.807	.811	.801	.812	.835	.834	.832	---
April	---	---	---	30.059	30.051	30.056	30.050	30.057	30.066	30.070	30.073	---
May	---	---	---	30.000	29.987	29.983	29.981	29.985	29.986	29.985	29.989	---
June	---	---	---	29.689	.680	.670	.674	.677	.687	.682	.679	---
July	.707	.707	.677	.671	.687	.690	.686	.688	.730	.688	.701	.67[illegible]

Diurnal Fluctuation of the Atmospheric Pressure.

The diurnal fluctuation, on the yearly average, was deduced from the above table as follows: The readings for August were interpolated from the July and September readings; from the observations at Van Rensselaer Harbor, Port Kennedy, and Baffin Bay, August mean = July mean — $0^{in}.009$, also August mean = September mean —$0^{in}.040$; applying these reductions, and taking the mean of the two results, we find for August the readings:—

	2h	4	6	8	10	Noon	2	4	6	8	10	12h
August	29.674	29.670	29.656	29.658	29.658	29.661	29.661	29.664	29.684	29.662	29.668	29.656

To supply the annual means for the hours midnight, 2, 4, 6 A. M., we have mean of 8, 10, noon, 2, 4, 6, 8, 10 for July, August, September, October = 29.668, and for the same hours, mean of the year = 29.828, hence correction to the means of four months at the hours midnight, 2, 4, 6 A. M. to refer them to the annual value = + .160.

We have consequently for the whole year:—

	2h	4	6	8	10	Noon	2	4	6	8	10	12h
Year	29.818	29.820	29.812	29.826	29.822	29.820	29.820	29.825	29.835	29.829	29.831	29.829

If we subtract from these numbers their average value, we find the diurnal variation proper as given below, to which that of Van Rensselaer Harbor, Port Kennedy, and Baffin Bay ($\varphi = 72.5$) have been added.

Diurnal fluctuation of the barometer.
(+ above mean, — below mean reading.)

Hour.	Port Foulke $\phi = 78° 18'$.	Van Rensselaer $78° 37'$.	Port Kennedy $72° 01'$.	Baffin Bay $72° 30'$.
2	$-0^{in}.006$	$0^{in}.000$	$-0^{in}.019$	$-0^{in}.010$
4	—.004	+.001	—.028	—.013
6	—.012	+.001	—.031	—.017
8	+.002	—.003	—.002	—.012
10	—.002	—.001	+.010	+.007
Noon	—.004	—.002	+.008	.000
2	—.004	—.006	+.011	+.002
4	+.001	—.002	+.014	+.010
6	+.011	+.002	+.015	+.013
8	+.005	+.004	+.018	+.013
10	+.007	+.006	+.009	+.010
12	+.005	+.003	.000	.000

Expressed analytically the above diurnal fluctuations are given by the equations:—

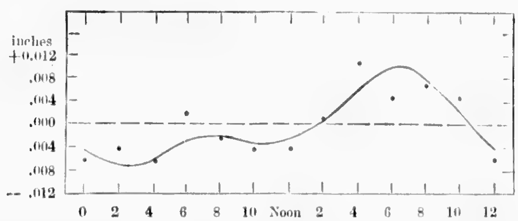
Port Foulke, $b = 0^{in}.006 \sin(\theta + 159°) + 0^{in}.004 \sin(2\theta + 186°)$
Van Rensselaer Harbor, $b = 0.003 \sin(\theta + 110°) + 0.002 \sin(2\theta + 204°)$
Port Kennedy, $b = 0.021 \sin(\theta + 202°) + 0.009 \sin(2\theta + 150°)$
Baffin Bay, $b = 0.013 \sin(\theta + 185°) + 0.004 \sin(2\theta + 159°)$

The angle θ counts from *midnight* at the rate of 15° an hour.

The general correspondence of these expressions is quite satisfactory; the most striking feature is the rapid diminution of the diurnal fluctuation with an increase of latitude; thus the coefficients of either term for Van Rensselaer Harbor are one-half of those for Port Foulke, and taking the average for these localities ($\phi = 78° 28'$) we have a diurnal range of only 0.013 inch, whereas the upper range for Port Kennedy and Baffin Bay ($\phi = 72° 15'$) is 0.038 inch; if this rate of diminution continues, the range would be less than 0.001 inch in latitude $81\frac{1}{2}°$.

The observed and computed diurnal fluctuation at Port Foulke is shown by the annexed diagram.

Diurnal Fluctuation of the Atmospheric Pressure.



By the aid of the curve we find the maximum to occur about $6\frac{1}{2}$ P. M.; at Van Rensselaer it occurred about 10 P. M., and at Port Kennedy and Baffin Bay about $7\frac{1}{2}$ P. M.; the principal minimum occurs about 3 A. M., at Van Rensselaer the (secondary) minimum occurred about 4 A. M., and at Port Kennedy and Baffin Bay

about $4\frac{1}{2}$ A. M. At Port Foulke, the secondary maximum and minimum occur about 8 and $10\frac{1}{2}$ A. M.: diurnal range 0.017 inch.

Annual Fluctuation of the Atmospheric Pressure.

The monthly mean values derived from the hours 8 A. M. to 10 P. M., which are strictly comparable, inter se, are as follows:—

September	29.^in^686	March	29.^in^818
October	29.620	April	30.060
November	30.089	May	29.987
December	30.034	June	29.680
January	29.836	July	29.693
February	29.749	August	29.664

The mean of these values is 29^in^.826, but the annual mean from 12 values a day was 29.824; we subtract therefore 0^in^.002 which gives the following monthly mean barometric pressure, and the annual fluctuation proper, + indicating greater, — less pressure than the mean amount.

Annual fluctuation of the atmospheric pressure.
Maximum marked by a *.

	Port Foulke.	Port Foulke.	Van Rensselaer.	Port Kennedy.	Baffin Bay.
January	29^in^.834	+0^in^.010	+0^in^.003	+0^in^.041	—0^in^.223
February	29.747	—0.077	+0.073	—0.005	—0.106
March	29.816	—0.008	—0.025	+0.235	+0.138
April	30.058	+0.234*	+0.128	+0.241*	+0.185
May	29.985	+0.161	+0.167*	+0.072	+0.259*
June	29.678	—0.146	—0.056	—0.025	+0.062
July	29.691	—0.133	—0.034	—0.234	—0.002
August	29.662	—0.162	—0.081	—0.197	—0.019
September	29.684	—0.140	—0.117	—0.039	—0.020
October	29.618	—0.206	—0.020	—0.140	+0.001
November	30.087	+0.263*	—0.017	+0.114	—0.090
December	30.032	+0.208	—0.022	—0.066	—0.185

The true maximum occurs evidently in April, that of November being accidental. The spring maximum (April and May) is well marked for either locality. The minimum at Port Foulke occurred in October; at Van Rensselaer Harbor in September. Computed annual range at Port Foulke 0.40 inch; at Van Rensselaer Harbor 0.21 inch.

We have also the annual fluctuation at

Port Foulke, $B = 0^{in}.120\ sin\ (\theta + 48^\circ) + 0^{in}.141\ sin\ (2\theta + 177^\circ)$
Van Rensselaer Harbor, $B = 0.079\ sin\ (\theta + 4\ ) + 0.044\ sin\ (2\theta + 294\ )$
Port Kennedy, $B = 0.137\ sin\ (\theta + 17\ ) + 0.106\ sin\ (2\theta + 232\ )$
Baffin Bay, $B = 0.155\ sin\ (\theta + 304\ ) + 0.113\ sin\ (2\theta + 236\ )$

The angle θ counts from January 1st at the rate of 30° a month.

The formula for Port Foulke places a maximum about the commencement of May, and a minimum about the end of August; it requires, however, more than one year's observation to secure a reliable value of the annual fluctuation.

The annual range is twenty times greater than the diurnal range.

Mean Atmospheric Pressure at the Level of the Sea.

We obtained the annual average value of the atmospheric pressure $29^{in}.824$; the reduction to the sea level is $+0^{in}.006$, hence the height of the barometer at the sea level in latitude

sea level in latitude		78° 18′	29.830 inches.
At Van Rensselaer Harbor in latitude		78 37	29.775 "
" Port Kennedy	" "	72 01	29.938 "
" Baffin Bay	" "	72 30	29.755 "
Average,		75⅓	29.824 "

Monthly and Annual Extremes of Pressure.

The following table contains the observed maxima and minima of atmospheric pressure in each month; attached thermometer at 32°. The corresponding range at Van Rensselaer Harbor has been added for comparison.

	Maximum.	Minimum.	Port Foulke range.	Van Rensselaer Har. range.
September	$30^{in}.13$	$29^{in}.27$	$0^{in}.86$	$1^{in}.41$
October	30.22	28.94	1.28	1.28
November	30.74	29.59	1.15	1.30
December	30.71	29.17	1.54	1.48
January	30.45	29.14	1.31	1.36
February	30.20	28.98	1.22	1.61
March	30.53	29.23	1.30	1.31
April	30.61	29.44	1.17	1.09
May	30.58	29.50	1.08	1.30
June	30.01	29.31	0.70	0.78
July	30.11	29.27	0.84	0.57
August	- - - -	- - - -	0.85[1]	0.83
Mean			1.11	1.17

[1] Interpolated.

The monthly range is greatest in winter and least in summer.

Observed absolute maximum and minimum and extreme range, referred to 32 Fah., and at the level of the sea:—

Maximum	$30^{in}.74$	November 25, 1860
Minimum	28.93	October 16, 1860
Range	1.81	

The extreme range at Van Rensselaer Harbor was 2.13 inches.

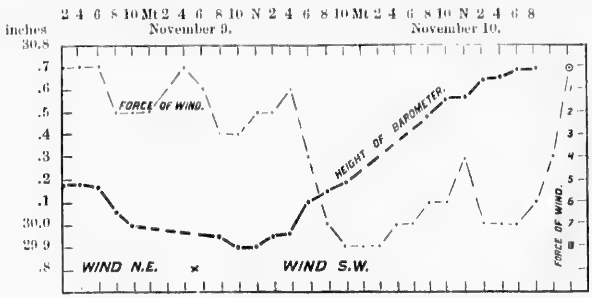
Relation of the Atmospheric Pressure to the Direction of the Wind.

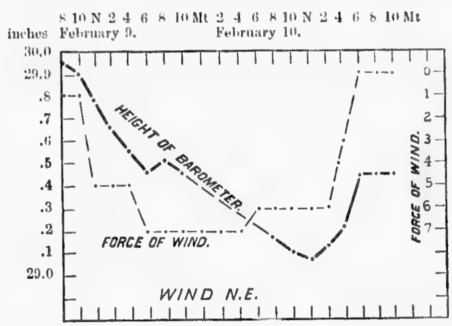
The changes of the barometric pressure, depending upon the direction of the wind, can only be investigated approximately from our observations, since the wind appears to blow principally from two directions, the number of entries from other directions being exceedingly few; besides, the series of barometric observations does not extend to a full year, and the daily observing hours are not symmetrically distributed over the twenty hours. By means of the preceding formula expressing

the annual fluctuation, the barometric height for each day was computed and subtracted from the observed height at the hours 8 A. M., noon, 4, and 10 P. M. These differences (positive for greater, negative for less pressure than the normal) were tabulated according to the direction of the wind. After balancing the resulting average effect for the directions (true) N. E. and S. W., and for calms, it appears that the barometric column is depressed about $0^{in}.07$ during N. E. wind, and elevated about $0^{in}.04$ during S. W. wind and during calms; at Van Rensselaer Harbor the depression during N. E. wind was $0^{in}.01$, and the elevation during S. W. wind $0^{in}.04$, and during calms $0^{in}.01$.[1]

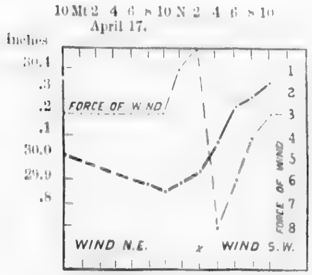
Oscillation of the Barometric Column during Storms.

There are 25 storms recorded (see discussion of winds), during one-third of which the barometer was notably affected; the range was between 0.3 and 0.9 of an inch. The readings of the barometer during the storms of November 9 and 10, 1860, of February 9, 1861, and of April 17, 1861, are illustrated by diagrams.





[1] See p. 108 of my Reduction of Captain McClintock's Meteorological Observations at Port Kennedy and Baffin Bay.



Note on Atmospheric Moisture

An attempt was made to obtain the vapor pressure by means of hygrometric observations between February 24 and April 16; wet bulb thermometer No. 1644 (covered with a thin coating of ice) was read once or three times a day. Comparing it with No. 3, I find its index correction, from nine comparisons during snow fall, $= -1°.8$ at the temperature $-15°$ Fah. The observations, however were found too rough, the greatest precision being required at these low temperatures when the relative humidity can be determined only approximately, though the numerical amount of vapor pressure (hardly exceeding $0^{in}.02$) may be well ascertained.

The dependence of the atmospheric moisture on the direction of the wind was found by means of tabulation of 128 cases of snow or rain with the direction of the wind.

During precipitation it blew 56 times from the S. W.; it was calm 45 times; and there were but 18 entries, mostly in summer, with N. E. wind; 7 with S. E., and 2 with W. wind. S. W. is therefore the rainy quarter, as might have been expected, and calms, generally, appear to favor precipitation.

WIND.

The direction and force of the wind at Port Foulke was recorded bi-hourly together with the observations of the temperature and pressure of the atmosphere. The record, here presented, will therefore extend over eleven months.

Dr. Hayes informed me that the direction of the wind was invariably recorded with reference to the *true* meridian.

The scale of force adopted is the same as that used in the Kane expedition, viz., from 0 (calm) to 10 (hurricane) in accordance with Smeaton's table.

Denomination of wind.	Estimated number of force.	Pressure in pounds per square foot.	Velocity in st. miles per hour.
Calm	0	0.000	0
Light air	1	0.005	1
Gentle breeze	2	0.08	4
Moderate breeze	3	0.9	13
Fresh breeze	4	2.6	23
Strong breeze	5	5.1	32
Fresh gale	6	7.9	40
Strong gale	7	12	50
Storm	8	18	60
Tempest	9	31	80
Hurricane	10	49	100

The force of the wind was estimated by the observers.

Direction (true) and force of the wind observed near and at Port Foulke.
September, 1860.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	N. E. 8	- - -	- - -	- - -	- - -	- - -	N. E. 5	- - -	- - -	- - -
4	"	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	"	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
8	"	N. 6	N. E. 5	E. N. E. 5	N. N. E. 7	calm	N. E. 5	N. E. 5	- - -	N. E. 5
10	"	N. by E. 6	"	N. N. E. 5	"	"	"	"	- - -	"
Noon	"	"	"	N. N. E. 7	N. N. E. 5	"	"	"	- - -	"
2	"	N. by E. --	"	"	- - -	"	"	"	- - -	N. 5
4	"	- - -	"	"	calm	"	"	N. E. 3	- - -	"
6	N. E. --	- - -	- - -	"	- - -	"	"	"	N. E. 3	"
8	N. W. 3	- - -	N. N. E. --	"	calm	"	"	"	- - -	"
10	N. W. --	- - -	"	"	"	"	"	"	- - -	N. 3
12	- - - 5	- - -	- - -	"	"	N. 5	- - -	- - -	- - -	- - -

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	- - -	N. E. 3	N. E. 4	- - -	- - -	calm	N. E. 6	N. E. 4	N. E. --	N. E. 5
4	- - -	"	"	N. E. 4	N. E. 4	"	"	"	N. E. 3	"
6	- - -	- - -	"	- - -	"	"	"	"	"	"
8	calm	N. E. 4	"	- - -	"	"	N. E. 5	"	"	"
10	"	"	"	N. E. 4	"	S. W. 2	"	- - -	"	"
Noon	"	N. E. 5	"	N. E. 5	"	- - -	N. E. 6	N. E. 5	"	N. E. 3
2	"	"	"	N. E. 4	N. E. 3	S. W. 2	N. E. 4	"	N. E. 2	N. E. 2
4	"	N. E. 3	"	- - -	N. E. 2	"	"	"	N. E. 1	N. E. 3
6	"	"	"	N. E. 4	"	N. E. 2	"	"	calm	"
8	"	N. E. 4	"	"	"	"	- - -	"	"	"
10	N. E. 3	"	"	"	calm	"	N. E. 5	N. E. 4	"	"
12	calm	"	N. E. 2	"	"	N. E. 3	"	"	N. E. 2	"

Hour	21st	22	23	24	25	26	27	28	29	30th
2 A.M.	N. E. 5	S. W. --	N. E. --	N. E. 8	N. E. --	- - -	- - -	S. E. 5	N. E. 8	N. E. 8
4	N. E. 3	"	N. E. 6	"	N. E. 3	N. E. --	- - -	S. E. 3	"	"
6	- - -	- - -	- - -	- - -	"	N. E. 3	- - -	calm	"	"
8	calm	S. W. 3	N. E. 6	N. E. 6	"	"	S. E. 3	N. E. 4	- - -	"
10	"	"	N. E. 8	"	- - -	"	- - -	calm	N. E. 6	N. E. 7
Noon	"	S. W. 2	- - -	"	- - -	"	- - -	N. E. 3	N. E. 8	"
2	"	S. W. 4	N. E. 8	"	N. E. 3	"	- - -	"	"	"
4	"	calm	"	"	"	N. E. 4	S. E. 6	N. E. 5	"	"
6	S. W. --	"	"	"	- - -	- - -	"	N. E. 8	"	"
8	- - -	"	"	"	N. E. 3	- - -	- - -	"	"	"
10	- - -	N. E. 3	"	"	"	N. E. 4	- - -	"	"	"
12	S. W. --	N. E. 5	"	- -	"	calm	S. E. 6	"	"	"

September 1, 8 A. M. to 4 P. M. Wind blowing almost a hurricane; hove to under bare poles.
September 9, 8 P. M. Blowing in squalls off shore.
September 23, 10 A. M. to midnight. Blowing in squalls, and very heavy.
September 28, 8 P. M. Wind blowing in heavy squalls.
September 29, midnight. Blowing heavy.

Direction (true) and force of the wind observed at Port Foulke

October, 1860

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	N. E. 8	N. E.--	- - -	W. --	calm	calm	S. W. 7	- - -	- -	N. E. -
4	- - -	"	calm	- - -	"	"	- - -	- - -	- -	"
6	N. E. 8	"	"	W. --	- - -	"	S. W. 7	S. -	- - -	- - -
8	"	"	"	"	N. --	"	"	"	calm	N. E. [illegible]
10	"	N. E. 3	"	"	calm	"	"	"	"	N. E. 4
Noon	"	calm	W. --	"	"	S. W. --	"	"	"	"
2	N. E. 6	"	W. 4	"	"	S. W. 6	"	S. 8	N. E. 2	N. E. 3
4	N. E. 5	"	W. 6	"	"	"	"	S. 7	"	N. E. 4
6	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	N. E. 4	calm
10	N. E. 4	"	"	"	"	"	"	"	N. E. 5	"
12	"	"	"	"	"	S. W. 7	"	S. S. W. 5	"	S. E. --

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	N. E. 1	calm	N. E.--	N. E.--	N. E.--	- - -	N. E.--	N. E. 4	N. E.--	N. E.--
4	N. E. 6	"	"	"	"	- - -	"	"	"	"
6	- - -	"	"	"	"	- - -	N. E. 4	"	"	"
8	- - -	"	N. E. 7	N. E. 7	N. E. 6	N. E. 6	calm	"	"	"
10	calm	S. W.--	"	N. E. 6	"	"	"	"	"	"
Noon	"	calm	"	"	"	"	"	"	N. E. 8	"
2	"	"	"	"	"	"	"	"	"	"
4	"	"	N. E. 6	N. E. 5	"	"	"	"	N. E. 6	"
6	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	"	N. E. 5	"	"	"	"
10	N. E. 2	"	"	N. E. 6	"	N. E. 4	"	"	"	"
12	S. E.--	N. E.--	"	"	"	"	"	"	"	- - -

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2 A.M.	N. E. 2	calm	N. E.--	N. E.--	N.E.--	calm	- - -	N.E.--	S.W.--	S.W.--	calm
4	"	"	"	"	"	N. E.--	N.--	"	"	"	"
6	N. E. 1	"	"	"	- - -	"	calm	"	"	"	"
8	calm	S. W.--	N. E. 4	calm	N.E.--	N. E. 4	"	calm	"	"	"
10	"	"	"	N. E. 3	N. E. 4	calm	"	S.W.--	"	"	"
Noon	"	"	"	"	calm	"	"	"	"	"	"
2	"	S. W. 1	N. E. 6	"	"	"	"	"	"	S. W. 1	N. E. 2
4	"	calm	"	"	"	"	N.W.--	"	"	calm	"
6	"	"	"	"	S. W. 2	"	"	"	"	"	N. E. 5
8	"	"	"	"	"	"	"	"	- - -	"	"
10	"	"	"	"	S. W. 4	"	N.E.--	"	- - -	"	N. E. 7
12	"	N. E.--	"	"	- - -	"	"	"	- - -	"	"

October 6, midnight. Blowing in heavy squalls.
October 7. Blowing in heavy squalls during the entire day.
October 8. Blowing in heavy squalls during the day.
October 9, 10 P. M. Blowing in squalls.
October 10, 8 A. M. Wind blowing in squalls.
October 14, 8 A. M. Blowing in heavy squalls.
October 29. Wind blowing in heavy squalls throughout the day.

Direction (true) and force of the wind observed at Port Foulke.
November, 1860.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	N. E.--	N. E.--	N. E.--	N. E.--	calm	calm	N.--	calm	N. E.--	S. W.--
4	"	"	"	"	"	"	"	"	calm	"
6	"	"	"	"	"	"	"	N. E.--	N. E --	"
8	N. E. 8	"	"	"	N. E. 1	N. E. 3	N. E. 4	N. E. 1	N. E. 3	S. W 6
10	"	"	"	"	"	"	"	calm	"	"
Noon	"	"	"	"	"	"	N. E. 2	S. W.--	N. E. 2	S. W. 4
2	"	"	"	"	"	"	"	calm	"	S. W. 7
4	"	"	"	"	"	"	"	"	N. E. 1	"
6	"	"	"	"	calm	"	N. E. 1	"	S. W. 4	"
8	"	"	"	"	"	"	S. W. 2	N. E. 2	S. W. 7	S. W. 6
10	"	"	"	"	"	"	S. W. 4	"	S. W. 8	S. W. 4
12	"	"	"	"	"	"	- - -	"	"	calm

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	calm	calm	calm	N. E.--	N. E.--	N. E.--	N. E.--	calm	N. E.--	N. E.--
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	N. E.--	N. E. 4	"
8	"	"	"	"	N. E. 3	N. E. 7	N. E. 2	N. E. 3	N. E. 3	N. E. 3
10	"	"	"	N. E. 7	"	"	"	"	N. E 5	"
Noon	"	"	"	"	"	"	calm	N. E. 1	N. E. 3	N. E. 2
2	"	"	"	"	"	"	"	N. E. 3	"	N. E. 1
4	"	"	"	"	"	"	"	"	"	calm
6	"	"	"	"	"	"	"	N. E. 4	N. E. 5	"
8	"	"	"	"	"	"	"	N. E. 5	"	"
10	"	"	N. E. 2	"	"	"	"	"	"	"
12	"	"	"	"	"	- - -	"	- - -	"	"

Hour	21st	22	23	24	25	26	27	28	29	30th
2 A.M.	S. E.--	N. E.--	N. E.--	N. E.--	calm	calm	calm	S. E.--	calm	S. W.--
4	"	"	"	"	"	N. E. 1	"	"	"	"
6	calm	"	"	"	"	"	"	"	"	"
8	"	N. E. 7	N. E. 7	N. E. 6	"	N. E. 6	"	S. W. 4	"	calm
10	"	"	"	"	"	"	"	"	"	"
Noon	"	"	"	N. E. 3	"	N. E. 3	"	"	"	"
2	"	"	"	calm	"	"	"	"	N. E. 2	"
4	"	"	"	"	"	"	S. W. 2	"	"	"
6	"	"	"	"	"	"	"	"	N. E. 4	"
8	"	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	N E.--	"	"	"	"	S. W. 2	"	calm	- - -	S. W.--

Direction (true) and force of the wind observed at Port Foulke
December, 1860

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	S. W. - -	S. W. - -	N. E. - -	calm	calm	N. E. - -	N. E. - -	N. E. - -	N. E. - -	N. E. - -
4	- - -	"	"	"	N. E. - -	"	"	"	"	"
6	S. W. - -	"	"	"	- - -	"	"	"	"	"
8	S. W. 8	calm	N. E. 4	"	N. E. 3	N. E. 7	N. E. 7	N. E. 8	N. E. 8	N. E. 8
10	"	"	"	"	"	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	"	"
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	"	N. E. 2	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	"	"	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	N. E. - -	S. E. - -	N. E. - -	N. E. - -	S. E. - -	N. E. - -	N. E. - -	S. W. - -	S. W. - -	S. W. - -
4	"	- - -	"	"	N. E. 1	"	calm	"	"	"
6	"	calm	"	"	"	"	"	"	"	"
8	N. E. 7	N. E. 1	N. E. 4	N. E. 4	N. E. 4	N. E. 5	"	calm	S. W. 5	S. W. 6
10	"	"	N. E. 6	"	"	"	"	"	"	"
Noon	"	"	"	calm	"	"	"	"	S. W. 3	"
2	N. E. 3	calm	"	"	"	"	"	"	calm	"
4	calm	"	"	"	"	"	"	"	N. E. 1	"
6	S. W. 1	"	"	"	"	"	"	"	N. E. 3	"
8	"	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	N. E. 1	"
12	"	- - -	"	"	"	"	"	"	S. W. - -	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2 A.M.	- - -	calm	calm	N. E. - -	N. E. - -	N. E. - -	calm	calm	N. E. - -	S. E. - -	calm
4	calm	"	"	"	"	"	"	- - -	"	calm	"
6	"	"	"	- - -	"	- - -	- - -	- - -	- - -	- - -	"
8	"	"	"	N. E. 2	N. E. 4	- - -	calm	- - -	N. E. - -	calm	"
10	"	"	"	"	N. E. 3	- - -	"	S. W. - -	N. E. 4	"	"
Noon	"	"	"	N. E. 3	"	- - -	"	S. W. 2	"	"	"
2	"	"	- - -	"	"	S. W. 1	"	- - -	"	"	"
4	"	"	- - -	N. E. 4	- - -	calm	- - -	N. E. 3	- - -	"	N. E. 2
6	"	"	- - -	"	- - -	"	- - -	N. E. 2	- - -	"	"
8	"	"	- - -	"	- - -	"	- - -	"	calm	"	"
10	"	"	N. E. 4	"	- - -	- - -	- - -	"	"	"	"
12	"	"	S. W. - -	"	- - -	calm	calm	N. E. - -	"	"	"

Direction (true) and force of the wind observed at Port Foulke.
January, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	- - -	N. E.--	N. E.--	calm	S. W.--	calm	N. E.--	- - -	calm	N. E.--
4	- - -	"	"	"	calm	"	"	S. E. 1	N. E.--	"
6	- - -	"	calm	"	"	"	"	"	"	"
8	N. E. 4	- - -	"	"	"	"	N. E. 6	S. E. 2	N. E. 5	N. E. 6
10	"	N. E. 5	"	"	"	"	"	S. E. 3	N. E. 7	"
Noon	"	"	"	"	"	"	"	S. E. 2	"	"
2	"	"	"	"	"	"	N. E. 4	"	N. E. 6	N. E. 3
4	"	"	"	"	"	N. E. 3	N. E. 2	"	"	calm
6	"	"	"	"	N. W. 1	"	calm	N. W.--	"	"
8	"	N. E. 3	"	S. W. 1	"	N. E. 2	"	"	"	"
10	- - -	"	"	S. W. 2	"	"	"	"	"	S. W. 1
12	N. E. 4	"	"	"	N. E.--	"	"	calm	"	calm

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	S. E.--	N. E.--	N. E.--	calm	calm	calm	S. W.--	calm	N. E.--	N. E.--
4	"	"	"	"	"	S. E.--	"	"	"	"
6	"	"	"	"	"	calm	- - -	- - -	"	"
8	"	N. E. 2	N. E. 7	"	"	"	calm	- - -	N. E. 6	N. E. 5
10	"	"	"	"	N. E. 1	"	"	calm	"	"
Noon	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	calm	"	"	S. E. 1	"	"
4	calm	"	"	"	"	"	"	N. E. 4	"	"
6	"	"	N. E. 4	"	"	"	"	"	"	"
8	"	"	N. E. 3	"	"	"	"	"	"	"
10	"	"	calm	"	"	"	"	"	"	"
12	N. E.--	"	"	"	N. E.--	S. W.--	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2 A.M.	N.E.--	N.E.--	calm	calm	calm	N.E.--	N.E.--	S. E.--	S.W. 1	N. E.--	calm
4	"	"	"	"	"	"	"	"	S.W. 3	"	"
6	"	"	"	S. E.--	"	"	"	"	"	"	"
8	N. E. 5	N. E. 5	"	S. E. 1	"	N. E. 5	S.W. 6	E. 1	"	"	"
10	"	N. E.--	"	N. E --	"	"	S.W. 2	"	"	E. 1	S. E. 1
Noon	"	N. E. 3	"	S. W. 2	N. E 3	"	"	calm	"	"	"
2	N. E. 3	- - -	"	"	"	"	S. E. 2	"	"	"	"
4	"	N. E. 2	"	S. W. 1	"	"	"	"	"	S.W. 1	S.W. 1
6	"	"	"	calm	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	S.W. 1	"	"
10	"	"	"	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	"	"	N. E.--	N.E.--	"

January 13, 10 A. M. to 8 P. M. Wind blowing in heavy squalls.

Direction (true) and force of the wind observed at Port Foulke
February, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	N. E.--	calm	N. E.--	E.--	N. E.--	- - -	[illegible]	calm	S. W.--	N. E.--
4	"	E. - - -	"	- - -	"	N. E.--		"	"	"
6	"	N. E.--	"	E.--	"	"		"	"	"
8	"	calm	- - -	N. E. 4	N. E. 3	"	"	N. E.--	N. E. 1	N. E. 6
10	N. E. 4	"	N. E.--	"	"	"	"	calm	"	"
Noon	N. E. 6	"	"	"	"	"	"	"	N. E. 5	"
2	"	S. E. 3	S. E.--	"	N. E. 2	"	"	"	"	"
4	N. E. 3	S. W.--	"	"	N. E. 4	N. E. 3	"	"	"	N. E. 3
6	calm	"	S. E. 1	"	"	"	"	"	N. E. 7	calm
8	"	"	calm	"	N. E. 3	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	N. E.--	S. E.--	"	"	calm	"	N. E.--	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	S. W.--	S. W.--	N. E.--	N. E.--	N. E.--	N. E.--	N. E.--	S. W.--	calm	calm
4	"	"	"	"	"	"	calm	"	"	- - -
6	"	"	calm	"	"	"	"	- - -	"	N. E.--
8	S. W. 1	"	"	N. E. 6	N. E. 5	N. E. 5	"	calm	"	"
10	"	S. W. 2	"	"	"	"	"	"	"	N. E. 4
Noon	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	S. W.--	"	"	"
4	"	"	"	"	"	"	calm	"	"	"
6	"	"	N. E.--	"	"	"	"	"	"	"
8	S. W. 3	"	N. E. 5	"	"	"	N. E. 1	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	N. E.--	"	"	"	"	"	"	"	"

Hour	21st	22	23	24	25	26	27	28th
2 A.M.	N. E.--	- - - -	calm	N. E.--	N. E.--	N.--	N.--	N. E.--
4	"	calm	"	"	- - - -	"	"	"
6	"	"	"	"	N. E.--	"	"	"
8	N. E. 3	"	"	N. E. 7	N. 7	N. 6	N. 5	N. E. 3
10	"	"	"	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"
2	"	"	N. E. 3	"	"	"	"	"
4	N. E. 2	"	"	"	"	"	"	"
6	"	"	"	"	"	N. 5	"	"
8	"	"	"	"	"	"	"	"
10	"	"	"	"	N. 8	"	"	"
12	"	"	"	"	"	"	"	"

Direction (true) and force of the wind observed at Port Foulke.
March, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	N. E.--	S. W.--	S. W.--	N. E.--	N. E.--	N. E.--	N. E.--	N. E.--	calm	N. E.--
4	"	"	"	"	"	"	"	"	N. E.--	"
6	"	"	calm	"	"	"	"	"	"	"
8	calm	S. E. 3	S. E. 2	N. E. 3	N. E. 3	N. E. 2	N. E. 3	N. E. 4	N. E. 1	N. E. 1
10	"	"	"	"	"	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"	"	"
2	"	"	S. E. 1	"	"	"	"	"	"	S. W. 1
4	"	S. E. 2	calm	"	"	"	"	"	"	S. W. 3
6	"	S. E. 1	N. E. 1	"	"	"	"	N. E. 1	N. E. 3	"
8	"	"	"	"	"	"	"	calm	"	"
10	"	"	"	"	"	"	"	"	"	"
12	S. W.--	"	"	"	---	"	"	"	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	S. W.--	S. W.--	N. E.--	calm	N. E.--	calm	N. E.--	calm	calm	N. E.--
4	"	"	"	"	"	"	"	"	S. W.--	"
6	"	"	calm	"	"	"	calm	"	N. E.--	"
8	S. E. 2	"	"	"	N. E. 5	"	"	---	N. E. 1	"
10	"	S. W. 3	N. E. 1	N. E. 2	"	N. E. 1	"	N. 2	"	N. E. 3
Noon	S. E. 1	S. W. 2	calm	N. E. 5	N. E. 3	calm	"	"	"	N. E. 1
2	"	"	"	"	"	"	"	"	"	"
4	"	"	S. E. 1	"	"	"	"	"	"	S. E. 1
6	S. E. 3	S. W. 4	"	"	S. 1	"	"	"	calm	N. E. 1
8	"	"	"	"	calm	N. E. 3	"	calm	N. E. 4	calm
10	"	"	"	"	"	"	"	"	"	"
12	"	N. E.--	calm	"	"	"	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2 A.M.	calm	N. E.--	calm	calm	calm	N. E.--	N. E.--	S. W.--	---	N. E.--	calm
4	"	"	"	"	S. W.--	calm	"	"	N.--	"	"
6	"	"	"	"	"	"	"	"	calm	"	N. E.--
8	"	N. E. 1	"	"	S. W. 1	"	N. E. 4	S. E. 4	"	N. E. 4	calm
10	"	calm	"	"	"	"	"	"	"	"	"
Noon	"	"	"	"	"	S. W.--	"	"	N. E.--	"	"
2	"	"	"	"	"	S. W. 3	N. E. 3	"	N. E. 4	N. E. 2	"
4	"	"	"	"	"	N. E. 1	N. 1	calm	"	N. E. 1	"
6	"	"	"	"	"	"	calm	S. E. 1	"	"	S. E. 1
8	"	"	"	"	"	"	"	"	N. E 3	calm	calm
10	N. E. 3	"	"	"	"	N. E. 5	---	"	"	"	N. E. 1
12	"	"	"	"	calm	"	S. W.--	"	---	"	calm

Direction (true) and force of the wind observed at Port Foulke

April, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	calm	S. W.--	N. E.--	N. E.--	S. W. 4	S. W.--	N. E.--	N. E.--	N. E.--	N. E.-
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	S. E.--	"	"	"	"	"
8	"	"	"	N. E. 1	S. E. 3	S. E. 1	N. E. 3	N. E. 3	"	N. E. [illegible]
10	"	S. W. 3	"	"	"	calm	N. E. 4	"	"	"
Noon	"	"	calm	N. E. 2	"	N. E. 1	"	"	"	"
2	S. E. 1	"	"	N. E. 4	"	"	"	"	"	"
4	S. E. 3	"	"	"	"	N. E. 3	"	"	"	"
6	S. E. 1	"	"	"	S. E. 5	"	"	"	"	"
8	S. E. 2	"	S. W. 1	"	"	N. E. 2	"	"	"	"
10	"	calm	calm	"	"	"	- - -	"	"	"
12	"	N. E.--	S. W.--	"	"	- - -	- - -	"	"	N. E. [illegible]

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	N. E.--	N. E.--	S. W. 1	S. W. 7	N. E. 1	N. E. 3	N. E. 3	S. W. 3	calm	calm
4	"	"	"	"	"	"	"	"	"	"
6	"	calm	S. W. 2	"	N. E. 3	"	"	calm	N. E. 2	"
8	N. E. 6	S. W. 1	"	"	"	"	"	"	"	S. W. 1
10	"	"	"	"	N. E. 4	"	"	"	N. E. 3	calm
Noon	"	"	"	S. W. 4	"	"	N. E. 1	N. E. 1	"	"
2	"	"	"	"	"	"	calm	calm	"	"
4	"	"	S. W. 4	S. W. 3	"	"	S. W. 8	"	"	"
6	"	S. W. 2	S. W. 6	calm	"	"	S. W. 6	"	"	"
8	N. E. 4	S. W. 3	"	S. E. 1	"	"	S. W. 4	"	calm	"
10	"	"	S. W. 7	"	"	"	S. W. 3	"	"	"
12	- - -	"	"	"	"	"	"	"	"	S. W. 1

Hour	21st	22	23	24	25	26	27	28	29	30th
2 A.M.	S. W.--	S. E.--	N. E.--	S. W.--	calm	calm	calm	N. E. 3	N. E.--	N. E. 7
4	"	S. W. 1	"	"	"	"	"	"	"	"
6	"	"	calm	"	"	"	"	"	"	"
8	S. W. 2	"	"	S. W. 2	S. W. 2	"	N. E. 1	"	N. E. 6	N. E. 2
10	"	"	"	"	S. W. 3	"	N. E. 3	"	"	"
Noon	S. W. 3	calm	"	"	"	"	"	"	"	"
2	S. W. 4	N. E. 1	"	"	"	"	"	N. E. 4	"	"
4	"	"	S. W. 1	"	"	"	"	"	"	"
6	"	"	S. W. 2	"	"	"	"	"	"	"
8	"	calm	"	"	S. W. 1	"	"	N. E. 5	"	"
10	"	N. E. 1	"	"	"	"	"	"	N. E. 7	"
12	"	"	"	"	"	"	- - -	"	- - -	"

April 5. Blowing in squalls throughout the day.
April 21. Wind blowing in heavy squalls throughout the day.

Direction (true) and force of the wind observed at Port Foulke.

May, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	N. E.--	N. E.--	calm	calm	S. W. 1	N. E.--	calm	S. W.--	calm	calm
4	"	"	N. E. 1	"	calm	"	"	"	"	"
6	"	"	"	"	"	"	"	calm	"	"
8	N. E. 3	N. E. 3	"	"	"	N. E. 1	"	"	"	"
10	"	"	"	"	N. E. 3	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	"	- - -	"	"	"	"
4	"	"	"	S. W. 1	"	calm	"	"	"	N. E. 2
6	"	"	"	"	"	S. W. 1	N. W. 1	"	"	"
8	"	N. E. 1	calm	"	"	calm	"	"	"	N. E. 3
10	"	"	"	"	"	"	"	"	"	"
12	"	calm	"	"	"	"	"	"	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	N. E.--	N. E.--	calm	S. W.--	calm	S. W.--	S. W.--	N. E.--	N. E.--	N. E.--
4	"	"	"	"		calm	"	"	"	"
6	"	"	"	calm	"	"	"	"	"	"
8	N. E. 3	N. E. 2	- - -	"	"	"	"	N. E. 2	N. E. 3	N. E. 2
10	"	"	S. W. 1	"	"	W.--	"	"	"	"
Noon	"	"	"	"	S. W.--	"	"	"	"	"
2	"	"	"	"	S. W. 2	"	"	"	"	"
4	"	"	"	"	S. W. 4	"	S. W. 1	"	"	"
6	"	"	calm	S. W.--	"	"	N. E. 1	"	"	"
8	"	calm	"	"	"	"	"	"	"	N. E. 1
10	- - -	"	"	"	"	"	"	"	"	"
12	N. E. 3	S. W.--	S. W.--	- - -	"	"	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2 A.M.	N. E.--	N. E.--	N. E.--	N. E.--	N. E.--	N. E.--	S. W.--	N. E.--	calm	N. E.--	N. E.--
4	"	"	"	"	"	"	"	"	N. E.--	"	"
6	"	"	"	"	"	"	"	"	N. E. 2	"	"
8	N. E. 1	- - -	N. E. 3	N. E. 4	N. E. 2	calm	W. 1	N. E. 1	"	N. E. 3	N. E. 6
10	calm	calm	"	"	"	"	"	S. W. 1	"	"	"
Noon	"	N. E. 2	"	"	"	"	"	S. W. 3	"	"	"
2	- - -	"	"	"	"	W. 1	N. E. 1	S. W.--	N. E.--	"	"
4	S. W. 1	"	"	"	N. E. 1	"	"	"	"	N. E. 4	"
6	"	"	"	"	"	"	"	"	"	N. E. 6	"
8	N. E. 1	"	"	"	N. E. 2	"	N. E. 2	S. W. 1	N. E. 3	N. E. 7	"
10	N. E. 2	"	"	"	"	"	"	calm	N. E. 5	N. E.--	"
12	"	"	"	"	"	"	"	"	"	"	- - -

May 30, 10 P. M. Wind blowing in heavy squalls.
May 31. Wind blowing in heavy squalls all day.

Direction (true) and force of the wind observed at Port Foulke
June, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2 A.M.	N. E.--	N. E.--	S. E.--	N. E.--	calm	N. E.--	N. E.--	N. E.--	N. E.--	N. E.--
4	"	"	N. E.--	"	N. E.--	"	"	"	"	"
6	"	"	"	"	"	"	"	"	calm	"
8	N. E. 5	N. E. 4	N. E. 3	N. E. 3	N. E. 1	N. E. 3	N. E. 4	N. E. 1	"	"
10	"	"	"	"	"	"	"	"	"	N. E. 2
Noon	"	"	"	N. E. 2	"	"	"	calm	"	"
2	"	"	"	- - -	"	"	"	- - -	"	"
4	"	"	"	calm	"	"	"	N. E. 1	"	"
6	"	"	"	"	"	"	N. E. 2	"	"	"
8	"	"	"	"	"	"	N. E. 3	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	"	"	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2 A.M.	N. E.--	calm	S. W.--	S. W. 1	S. W.--	S. W.--	S. W.--	S. W.--	S. W.--	- - -
4	"	"	"	"	"	"	"	"	"	-
6	"	S. W.-	"	"	"	"	"	"	"	- - -
8	"	"	"	"	S. W. 2	S. W. 7	S. W. 7	S. W. 5	S. W. 5	S. W. 2
10	"	S. W. 2	calm	"	"	"	"	"	"	"
Noon	calm	"	S. W. 1	"	"	"	"	"	"	"
2	"	"	"	"	"		"	"	"	"
4	"	S. W. 3	"	"	"	S. W. 6	"	"	"	"
6	"	S. W. 2	"	calm	"	"	"	"	"	"
8	"	"	calm	"	"	S. W. 7	"	"	"	"
10	"		"	"	"	- - -	"	"	"	"
12	S. W.--		"	S. W.-	"	"	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30th
2 A.M.	S. W.--	calm	calm	calm	S. W.--	S. W.--	S. W.--	calm	calm	calm
4	"	"	"	"	"	"	"	N.--	"	"
6	"	"	N. E.--	"	"	"	"	calm	"	"
8	- -	"	"	"	S. W. 7	S. W. 7	S. W. 5	"	"	"
10	calm	S. W. 1	N. E. 1	"	"	"	"	"	"	"
Noon	"	"	"	N. 1	"	"	"	"	"	"
2	"	"	- - -	- - -	"	"	"	"	"	"
4	"	"	S.--	S. W. 1	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	"	calm	calm	"	"	"	"	"	"	"
10	"	- - -	"	"	"	"	"	"	"	S. W. 1
12	- - -	S. W.--	S. W.--	S. W.--	"	"	"	"	"	"

June 16, 8 A. M. to midnight. Blowing in squalls.
June 17, 18. Blowing in heavy squalls throughout the day.
June 19. Wind blowing in squalls.

Direction (true) and force of the wind observed at and in the vicinity of Port Foulke.
July, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10	11	12th
2 A.M.	S.W.--	S.W.--	- - -	N.E.--	N.E.--	N.E.--	N.--	N.E.--	N.E.--	N.E.--	S.W.--	calm
4	"	"	S.W.--	S.W.--	"	"	N.E.--	"	"	"	"	S.W. 1
6	"	"	"	"	"	"	"	"	"	"	- - -	N.E. 1
8	"	calm	S. 1	S.W. 2	N.E. 3	N.E. 3	calm	"	N.E. 1	N.E. 6	S.W. 2	"
10	calm	"	"	"	S.W. 1	"	"	calm	"	"	"	N.E. 2
Noon	"	"	calm	"	"	N.E. 1	"	N.E. 2	- - -	"	"	"
2	"	"	"	"	"	"	"	S.W. 1	S.W. 1	N.E.--	S.W. 1	"
4	"	"	"	S.W. 1	calm	calm	"	S.W. 2	calm	S.W. 2	calm	N.E. 1
6	S.W. 1	"	"	calm	"	"	"	calm	"	S.W. 1	"	calm
8	"	N.E. 1	"	"	"	"	N.E. 1	"	"	- - -	"	S.W.--
10	"	"	"	"	N.E. 2	"	N.E. 2	S.W. 1	"	- - -	"	- - -
12	"	calm	"	"	"	N.--	"	calm	N.E.--	calm	N.E.--	- - -

Hour	13th	14[1]	15	16	17	18	19	20	21	22	23d
2 A.M.	S.W.--	calm	calm	S.W. 6	S.W. 7	S.W. 4	S.W. 3	N. E. 1	S. W. 1	S. W. 3	N. E. 2
4	"	"	"	"	"	"	"	"	calm	S. W. 4	"
6	- - -	"	"	S.W. 7	"	"	"	"	S. W. 1	S. W. 2	"
8	S.W.--	"	"	"	"	"	"	"	"	"	"
10	"	- - -	"	"	S.W. 4	"	"	"	"	"	N. E. 1
Noon	"	S.W. 1	"	"	"	"	"	"	"	- - -	"
2	"	calm	S.W. 4	"	S.W. 6	S.W. 3	S.W. 1	calm	calm	S. W. 2	- - -
4	S. 1	"	"	"	S.W. 5	"	"	S. W. 1	"	"	calm
6	"	"	"	"	S.W. 4	"	calm	"	"	S. W. 1	"
8	calm	"	"	"	S.W. 6	S.W. 4	"	"	S. W. 1	S. W. 2	S. W. 1
10	"	"	S.W. 6	"	"	S.W. 3	"	"	"	S. W. 1	"
12	"	"	"	"	S.W. 4	"	N. E. 1	"	S. W. 3	"	"

Hour	24th	25	26	27	28	29	30	31st
2 A.M.	S. W. 1	N.N.E. 2	N. E. 1	N. E. 1	N. 1	calm	E. N. E. 1	calm
4	"	N.N.E. 1	"	"	"	"	"	"
6	"	"	calm	"	calm	"	"	W. N. W. 1
8	"	"	"	"	"	"	calm	W. N. W. 2
10	N. E. 1	calm	"	S. S. E. 3	"	"	variable	W. 1
Noon	"	"	N. E. 1	N. 1	"	"	N. W. 1	N. W. 1
2	- - -	"	calm	N. E. 2	"	S. S. W. 1	S. E. 1	E. S. E.--
4	N. E. 2	"	"	N. E. 1	"	calm	S. W. 2	- - - - -
6	N. N. E. 3	"	"	W. 1	"	"	S. S. W. 2	E. by N.--
8	"	S. E. 1	N. E. 1	W.N.W. 1	"	"	S. S. W. 1	E. by N. 2
10	N. N. E. 4	"	"	calm	"	"	S. S. W. 3	E.--
12	N. N. E. 2	calm	"	"	"	variable	S. S. W. 2	"

July 10, 8 A. M. Blowing in squalls.

[1] After July 14, noon, the record is given in "sea days," or astronomical reckoning, which is here changed to civil reckoning.

Method of Reduction

The same method of discussion will be employed here as that used for Dr. Kane's and Sir F. L. McClintock's observations.

Let $\theta_1 \quad \theta_2 \quad \theta_3 \ldots$ be the angles which the direction of the wind makes with the meridian (true), reckoned round the horizon according to astronomical usage, from the south, westward to 360°, a direction corresponding to that of the rotation of the winds in the northern hemisphere; and $v_1 \quad v_2 \quad v_3 \ldots$ its respective velocities, which may be supposed expressed in miles per hour, and let the observations be made at equal intervals (for instance hourly). Adding up all velocity-numbers referring to the same wind during a given period (say one month), and representing these quantities by $s_1 \quad s_2 \quad s_3 \ldots$ the number of miles of air transferred bodily over the place of observation by winds *from* the southward is expressed by the formula,

$$R_s = s_1 \cos \theta_1 + s_2 \cos \theta_2 + s_3 \cos \theta_3 + \text{----}$$

and for winds *from* the westward

$$R_w = s_1 \sin \theta_1 + s_2 \sin \theta_2 + s_3 \sin \theta_3 + \text{----}$$

The resulting quantity R, and the angle ψ it forms with the meridian, are found by the expressions

$$R = \sqrt{R_s^2 + R_w^2} \qquad \text{and } \tan \psi = \frac{R_w}{R_s}$$

The general formulæ, in the case of eight principal directions θ, assume the following convenient form:—

$$R_s = (S-N) + (SW-NE)\sqrt{\tfrac{1}{2}} - (NW-SE)\sqrt{\tfrac{1}{2}}$$
$$R_w = (W-E) + (SW-NE)\sqrt{\tfrac{1}{2}} + (NW-SE)\sqrt{\tfrac{1}{2}}$$

where the letters S, SW, W, etc., represent the *sum* of all velocities expressed in miles per hour, during the given period, or the quantity of air moved in the directions S, SW, W, etc., respectively. R_s represents the total quantity of air transported *to* the *northward*, and R_w the same transferred *to* the *eastward*. These formulæ, for practical application, may be put in the following convenient form:—

$$\text{Let} \quad S-N = a \qquad SW-NE = c$$
$$W-E = b \qquad NW-SE = d$$

Then

$$R_s = R \cos \psi = a + 0.707\,(c-d)$$
$$R_w = R \sin \psi = b + 0.707\,(c+d)$$

Since $R_s \quad R_w \quad R$ represents the quantity of air passed over during the given period, in the direction 0° 90° ψ° respectively, we must, in order to find the average velocity for any resulting direction, divide by n or by the number of observations during that period; we then have

$$V_s = \frac{R_s}{n} \qquad V_w = \frac{R_w}{n} \qquad \text{and } V = \frac{R}{n}$$

A particle of air which has left the place of observation at the commencement of the period — of a day, for instance — will be found at its close in a direction $180° + \psi$ and at a distance of R miles, equal to a movement with an average velocity of $\frac{R}{n}$. This supposes an equal and parallel motion of all particles passing

over the locality; the length of the path described by each can be found by the summation of all the v's (for each hour) during the period.

The great variability in the direction and force of the wind demands long periods for which it may be desirable to bring out resulting values. A subdivision of the reduction into monthly periods has been found convenient.[1]

No special advantage would be gained by including more than eight directions, and in the few cases where such intermediate directions were recorded they will be referred to the nearest principal direction, and if midway between and occurring more than once, they will be referred alternately to the preceding and following direction.

Occasional omissions in the record were supplied by interpolation; it is to be regretted that so many blanks occur in the column for force of the wind.

The following table gives the sum of the velocity-numbers for each month and for each of the principal eight directions of wind; also the resulting numbers for each season of the year as deduced from bi-hourly observations by application of the preceding method.

The numbers for August were interpolated by taking the mean of the July and September numbers.

True Direct'n	1860.				1861.												
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug. interpol'd.	Autumn.	Winter.	Spring.	Summer.	Year.
S.	0	564	0	0	0	0	1	0	0	1	33	16	564	0	1	50	615
N.	995	2	3	0	0	1342	21	0	0	2	4	500	1000	1342	21	507	2870
W.	0	380	0	0	0	0	1	0	17	0	5	2	380	0	18	6	404
E	64	0	0	0	5	4	0	0	0	0	21	42	64	9	0	63	136
S. W.	57	1476	893	1150	187	103	214	1176	181	3652	1705	881	2426	1440	1571	6238	11675
N. E.	7452	4425	5229	5476	3671	3750	1989	2884	2368	1300	394	3923	17106	12897	7241	5617	42861
N. W.	148	3	0	0	6	0	0	0	4	0	6	77	151	6	4	83	244
S. E	310	2	5	3	82	17	238	226	0	1	11	161	317	102	464	173	1056

Quantity of air passed over the place of observation, during a year, 59861 miles; at Van Rensselaer Harbor 12759, Baffin Bay 62993, and Port Kennedy 68108.

Applying the formulæ for reduction to these numbers, they give the resulting quantity of air, R, passed over during the period, and its direction ψ.

[1] A full illustration and example of the method of reduction will be found on page 63 of my reduction of Captain McClintock's Meteorological Observations. Smithsonian Contributions to Knowledge, 1862.

	R	[illegible]	[illegible]
September	8158	222	N. E. ½ N.
October	2286	228	N. E. ½ E.
November	4338	225	N. E.
December	4325	225	N. E.
January	3488	226	N. E.
February	4691	214	N. E. [illegible] N.
March	1802	232	N. E. [illegible] E.
April	1723	233	N. E. [illegible] E.
May	2174	225	N. E.
June	2351	45	S. W.
July	1319	43	S. W. [illegible] S.
August	3420	215	N. E. [illegible] N.
Autumn	14769	224	N. E.
Winter	12439	221	N. E. ½ N.
Spring	5687	229	N. E. ½ E.
Summer	321	82	W. ½ S.
Year	32600	223	N. E.

The resulting direction of the wind at Port Foulke during the period of one year is from the N. E. (true), which agrees with the general movement of the atmosphere in the Arctic regions as made out by Prof. J. H. Coffin;[1] the resulting directions at Van Rensselaer[2] S. S. W. nearly, and in Baffin Bay (latitude 72°.5, longitude 65°.8) N. W. by N. do not agree with this deduction, but whether this is owing to anomalous local influences, or whether it points to a modification of the law can only be settled when a greater number of observations will have been discussed, at present it appears most likely due to local circumstances.

Relative Frequency of each Wind and of Calms.

The following table of numbers of relative frequency contains the number of entries, n, of each wind and of calms.

True directions.	1860. Sept.	1860. Oct.	1860. Nov.	1860. Dec.	1861. Jan.	1861. Feb.	1861. Mar.	1861. April	1861. May	1861. June	1861. July	1861. Aug.	Autumn.	Winter.	Spring.	Summer.	Year.
S.	0	12	0	0	0	0	1	0	0	1	6	3	12	0	1	10	23
N.	28	2	3	0	[illegible]	[illegible]	6	0	0	2	5	16	33	33	6	23	95
W.	0	19	0	0	0	0	1	0	17	0	4	2	19	0	18	6	43
E.	2	0	0	0	5	4	0	0	0	0	15	9	2	9	0	24	35
S. W.	15	58	37	45	34	34	41	97	46	155	130	72	110	113	184	357	764
N. E.	249	171	199	189	166	170	163	177	215	110	83	166	619	525	555	359	2058
N. W.	5	3	0	0	6	0	0	0	4	0	6	5	8	6	4	11	29
S. E.	13	2	5	3	31	5	36	21	0	1	5	9	20	39	57	15	131
Calms	48	105	116	135	130	90	124	65	90	91	118	90	269	355	279	299	1202

[1] Twelfth meeting of the Am. Association, Baltimore, 1858.

[2] See note on page 66 of Captain McClintock's Meteorological Discussions, explaining the change from magnetic to true direction at this harbor.

If we double the numbers in each column, we find the number of hours during which each wind blew, or during which it was calm, for each period. The prevailing wind is the N. E., next to it the S. W., while the relative frequency of the calms is between the two; all other winds are about equally unfrequent. Expressed in percentage the frequency of the N. E. is 47, of calms 27, of S. W. 17, and for the six remaining directions on the average 1½.

Table of comparison of relative frequency of winds and calms.

True direction.	Port Foulke.	Van Rensselaer.	Baffin Bay.	Port Kennedy.
S.	23	410	243	44
S. W.	764	354	345	159
W	43	116	426	488
N. W.	29	330	1233	1670
N.	95	144	520	121
N. E.	2058	27	456	1104
E.	35	56	299	108
S. E.	131	411	503	114
Calms	1202	2532	341	561

This table exhibits the extreme variations in the frequency of the winds at different localities and in different years; at Van Rensselaer Harbor, with a northwest exposure, the N. E. wind is least frequent; at Port Foulke, with a west exposure, it is the most frequent wind. At the latter place the number of hours of calms is half that noted at the former place.

Average Velocity of the Wind.

The average velocity of each of the eight principal winds for each season and year is found by dividing the sum of the velocity numbers by n, or the number of entries during the period; the velocity is expressed in miles per hour.

True direction.	Velocity.
S.	27
S. W.	15
W.	9
N. W.	8
N.	30
N. E.	21
E.	4
S. E.	8

Average velocity of all winds throughout the year 19 miles per hour, producing a moderately fresh breeze. The average velocity of the air, taking also the number of calms into consideration, is 14 miles per hour. At Van Rensselaer Harbor the average velocity of all winds was 7, in Baffin Bay 17, and at Port Kennedy 18 miles per hour. These numbers are not strictly comparable, since the velocity of the wind at each locality depends upon estimation.

The velocities of the N. E. and S. W. winds alone are tolerably well ascertained, there being too few entries of other winds.

With respect to the application of the law of rotation of winds to this locality the record, containing mostly N. E. and S. W. directions with many calms, does not appear to be sufficiently well suited to give value to any result that might be deduced.

Occurrence and Duration of Storms.

In the following list all storms are included during which the force of wind reached the conventional numbers 7 and 8.

Date.			Duration.	Direction.	Remarks.
1860.	September	1	16^h	N. E.	
	"	4, 5	24	N. N. E.	
	"	23, 24	20	N. E.	Barometer fell about 0[illegible]
	"	28, 29, 30, 1	68	N. E.	
	October	6, 7, 8	43	S. W.	
	"	13, 14	16	N. E.	Barometer fell about $0^{in}.4$
	"	19	4	N. E.	
	"	31, 1	28	N. E.	
	November	9, 10	18	N. E. and S. [illegible]	Barometer strongly affected; [illegible] rose 0[illegible] after the gale
	"	14	16	N. E.	Barometer fell slowly
	"	16	16	N. E.	Barometer fell gradually and slowly
	"	22, 23	42	N. E.	
	December	1	18	S. W.	
	"	6, 7, 8, 9, 10, 11	126	N. E.	
	January	9	4	N. E.	Barometer fell about $0^{in}.3$
	"	13	10	N. E.	Barometer fell about $0^{in}.4$[illegible]
	February	9	8	N. E.	Barometer fell about $0^{in}.85$
	"	24, 25	42	N. E. and N.	Barometer slightly affected
	April	13, 14	14	S. W.	
	"	17	2	N. E. and S. W.	Barometer rose $0^{in}.5$ after the gale
	"	29, 30	10	N. E.	Barometer fell about 0[illegible]
	May	30	2	N. E.	
	June	16, 17	38	S. W.	Barometer but little affected
	"	25, 16	42	S. W.	
	July	16, 17	28	S. W.	

Of these 25 storms, which were recorded during 11 months, 19 came from the N. E., and 6 from the S. W.; their average duration was 26 hours. During more than one-half of these storms the barometer was not or very slightly affected. The storms appear more frequent in winter than in summer. None of the gales noted can be classed among the rotatory storms, excepting that of November 8 and 9, 1860, and that of April 17, 1861; during these two storms the wind shifted from N. E. to S. W., with an interval of calm in the latter case.

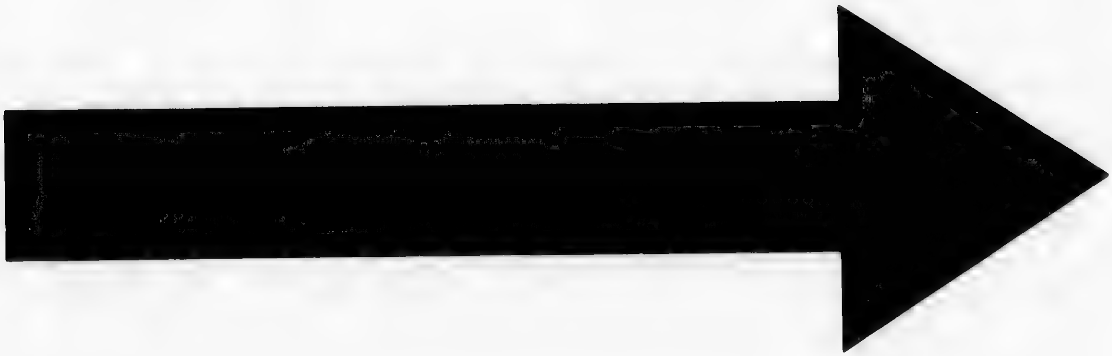


IMAGE EVALUATION
TEST TARGET (MT-3)

APPENDIX.

RECORD OF THE WEATHER AND MISCELLANEOUS NOTES.

Record of the weather kept on board the schooner "United States," and at Port Foulke, North Greenland, between July 11, 1860, and October 9, 1861.

The state of the weather is indicated by the following letters[1] (Beaufort's notation):—

b	blue sky.	*p*	passing showers.
c	clouds (detached).	*q*	squally.
d	drizzling rain.	*r*	rain.
f	foggy.	*s*	snow.
g	gloomy.	*t*	thunder.
h	hail.	*u*	ugly (threatening) appearance
l	lightning.	*v*	visibility, objects at a distance unusually visible.
m	misty (hazy).	*w*	wet (dew).
o	overcast.	*z*	snow-drift.

A bar (—) or a dot (.) under any letter augments its signification.

In the following record the date adopted is that in accordance with civil reckoning; on the voyage out and on the home trip astronomical reckoning is used in the log-book, which has been changed accordingly.

[1] Beaufort's notation is not employed in the records of the expedition, but the state of the weather is described in full.

Left Boston Bay 5½ A. M. July 10, 1860.

	July 11, 1860.					July 12.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	variable	--	--	--	*q r*	W. 3	29in.85	63°	55°.0	*b*	Thermometer No. 7 was used to indicate the temperature of the air.
4	"	--	--	--	"	"	--	--	--	"	
6	"	--	--	--	*b*	"	.90	61	54.4	"	
8	"	--	--	--	"	N. W. 3	.90	62	54.4	"	
10	N.	--	--	--	*c*	"	--	--	--	"	
Noon	N. 3	--	--	--	"	"	.90	61	68.0	"	
2	W. 3	29in.75	67°	64°	"	W. 2	30.00	63	55.0	"	
4	"	.75	65	63	"	"	29.95	62	59	"	Thermometer No. 9 was used for temp. of water, the mean of all obser's during 24 hours is given.
6	"	30.10	63	58.5	"	"	.95	62	54	"	
8	"	.10	63	56.5	"	"	.90	58	54	"	
10	"	--	--	56.5	"	"	.93	57	52	"	
12	"	29.80	62	56	"	"	.95	57	53	*c*	

At noon φ = 42° 24′ λ = 68° 05′ by obs'n.
42 29 68 24 by Dead reck.
Temp. water 56°.2; W. var'n ¾ pt.

At noon 42° 36′ 65° 32′ by obs'n.
42 38 65 25 D. R.
T. W. 53°.5; W. V. ¾ pt.

	July 13.					July 14.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	W. 3	--	--	--	*c*	E. N. E. 3	29.95	62	53	*r*
4	"	30.10	56	52	"	N. E. 3	--	--	--	"
6	"	--	--	--	"	"	30.00	60	53	*o*
8	"	.15	63	56.5	*m*	"	29.85	59	54.5	"
10	"	--	--	--	"	E. N. E. 2	30.00	60	55	*c*
Noon	"	29.80	62	55	"	"	.00	60	54	*b*
2	S. 2	30.00	62	55.5	"	var. 1	.00	64	68	--
4	"	.00	63.5	55	*o*	"	.05	66	67	--
6	"	29.90	60	55	"	calm	.05	63	66	--
8	S. E. 3	.95	60.5	56	*r*	W.	--	--	--	--
10	"	.95	63.5	54	"	"	.10	62	60	--
12	E. S. E. 3	.95	62	53	"	"	--	--	--	--

At noon 43° 00′ 63° 50′ by obs'n.
42 57 63 57 D. R.
Temp. water 55°.0; W. var'n 1 pt.

At noon 43° 18′ 63° 00′ by obs'n.
43 07 62 35 D. R.
T. W. 56°.9; W. var. 1 pt.

	July 15.					July 16.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	calm	30.10	61.5	55	--	E. N. E. 1	30.00	60	54	*o*
4	S.	.10	61.5	56	--	"	--	--	--	*r*
6	"	.10	62	56	--	"	29.90	60	55	"
8	"	.10	62	57	--	"	--	--	--	*c*
10	"	--	--	--	--	"	--	--	--	"
Noon	"	--	--	--	--	"	--	--	--	--
2	E. S. E.	--	--	--	*m*	W.S.W. 2	.93	65	64	*b*
4	E. N. E. 1	.10	62	56	"	"	.85	65	65	"
6	"	--	--	--	"	W.S.W. 3	.85	64	65	"
8	"	--	--	--	*o*	"	.80	63	57	"
10	"	--	--	--	"	"	.75	60	55.5	*m*
12	"	--	--	--	"	W.S.W. 4	--	--	--	"

At noon 43° 42′ 62° 17′ by obs'n.
43 35 62 15 D. R.
Temp. W. 56°.6; W. var. 1½ pts.

At noon 43° 53′ 61° 38′ by obs'n.
43 57 61 29 D. R.
T. W. 57°.1; W. var. 1½ pts.

Hour	July 17. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	July 18. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	W.S.W. 4	29in.80	64°	52.5	*m*	- - -	- -	- -	- -	*m*
4	W.S.W. 5	.85	64	53	"	- - -	- -	- -	- -	"
6	"	.75	64	53	"	- - -	- -	- -	- -	"
8	"	.70	65	55	"	- - -	29.90	64	[illegible]	"
10	"	.70	62	58	"	- - -	.80	64	54	"
Noon	"	- -	- -	- -	"	- - -	.75	62	54	"
2	"	.85	64	57	*c*	calm	30.00	66	58	"
4	"	.85	63	57	"	"	.00	65	- -	"
6	"	.80	63	56	"	"	.10	65	60	"
8	"	.80	63	55	*m*	"	.20	62	57	"
10	W.S.W. 4	.80	63	54	"	S. S. E. 1	.25	62	53	"
12	W.S.W. 1	.90	63	55	"	S. S. E. 2	.25	63	52	"

July 17. At noon 45° 2′ 58° 26′ by obs'n.
45 11 58 19 D. R.
T. W. 53°.1; W. var. 1¾ pts.

July 18. At noon 45° 26′ 56° 47′ D. R.
T. W. [illegible] 4.

Hour	July 19. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	July 20. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Remarks
2	S. S. E. 2	30.20	62	52	*m*	S. S. W. 5	30.00	65	50	*f*	July 19, 7 A. M., sounding 27 fath'ns. coarse gravel; at noon 40 fathoms, broken shells.
4	"	.20	61	51	"	"	- -	- -	- -	"	
6	"	.20	59.5	51	"	"	.00	58	52	"	
8	S. S. E. 3	.25	59	50.5	"	"	29.90	59	53		
10	S. S. E. 4	.20	59	50.5	"	"	.90	60	53	*f r*	
Noon	"	.30	72	51.5	"	"	.95	60	53	"	
2	S. S. W. 2	.10	67.5	53	*f*	S. S. W. 4	.95	60	53	"	July 20, 8 A. M., dense fog; made the land about St. Shots, 40 yards ahead.
4	S. S. W. 1	.00	63	53	"	"	75	63	53	*c*	
6	calm	29.90	60.5	51	"	"	.80	64	54	*f*	
8	S. S. W. 1	.90	61.5	51	"	"	.80	64	54	"	
10	"	.95	62	50	"	"	.75	64	54	*f r q*	
12	S. S. W. 3	30.10	62	49	"	"	.80	63	53	"	

July 19. At noon 45° 45′ 55° 54′ by D. R.
T. W. 51°.8; W. var. 2¼ pts.

July 20. At noon 46° 38′ 53° 50′ by land fall.
46 21 54 08 D. R.
T. W. 48°.3; W. var. 2¼ pts.

Hour	July 21. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	July 22. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Remarks
2	S. S. W. 4	- -	- -	- -	*r q*	S. W. 6	29.85	58	51	*f u q*	July 22, 8 P. M., variation 3 pt. W. by sun.
4	"	29.80	62	53.5	*r*	"	.80	58	51.5	"	
6	"	.85	61	54	"	"	- -	- -	- -	"	
8	"	.90	61	- -	*f q*	"	.34	57	52	"	
10	"	- -	- -	- -	"	"	.35	56	51	"	
Noon	"	- -	- -	- -	*f*	"	.45	58	51.5	"	
2	S. W. 5	.95	69	53	*f u q*	"	.30	56	52	*h*	
4	"	.80	64	53	"	"	.35	57	52	"	
6	"	.90	64	52	"	N. W. 4	.40	56	50	"	
8	S. W. 6	.80	63	53	"	"	.34	57	47	"	
10	"	.80	63	52	"	"	.30	57	47	"	
12	"	.80	60	52	"	"	.50	55	46	"	

July 21. At noon 47° 13′ 51° 20′ by D. R.
T. W. 50°.0; W. var. 2½ pts.

July 22. At noon 50° 24′ 50° 55′ by D. R.
T. W. 49°.0; W. var. 3 pts.

Hour	July 23. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	July 24. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	W.S.W. 5	29in.50	54°	45°	*b*	W.S.W. 6	- -	- -	- -	*b*	July 23, 8 P. M. saw first iceberg to the westward.
4	W.S.W. 6	- -	- -	- -	"	"	- -	- -	- -	"	
6	"	.75	56	45	"	"	- -	- -	- -	"	
8	"	.80	58	46	"	"	29in.85	52°	48°	"	
10	"	.80	60	46	"	"	.80	51	48	- -	
Noon	"	.80	69	46	"	"	.80	54	48	- -	
2	W.S.W. 5	- -	- -	- -	"	S. W. 5	.60	55	48	*c*	
4	"	- -	- -	- -	"	"	.50	55	48	*r b*	
6	"	.80	60	48	"	"	.40	53	47	"	
8	"	.80	60	47	"	"	.35	46	43	- -	
10	"	.80	59	46.5	"	"	- -	- -	- -	- -	
12	"	- -	- -	- -	"	N. W. 7	- -	- -	- -	- -	

July 23. At noon 52° 0′ 50° 42′ by obs'n.
52 49 51 07 D. R.
T. W. 42°.6.

July 24. At noon 54° 23′ 51° 17′ by obs'n.
54 26 51 10 D. R.
T. W. 42°.9; W. var. $3\frac{3}{4}$ pts.

Hour	July 25. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	July 26. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N. W. 8				- -	W.S.W. 3	29.70	54	45	*r*
4	N. W. 7				- -	"	.65	54	45	*b*
6	N. W. 6				- -	W.S.W. 4	- -	- -	- -	"
8	N. W. 5	29.40	67	46	*c*	"	.60	53	46	"
10	"	.50	68	46	"	"	.65	60	46	"
Noon	"	- -	- -	- -	- -	"	.70	69	47	"
2	S. W. 4	.70	75	48	*b*	S. W. 3	.75	58	43	"
4	"	.75	81	51	"	S. W. 4	.65	58	43	*c*
6	"	.70	58	52	"	S. W. 5	.60	58	46	"
8	W.S.W. 4	.60	56	49	*c*	"	.70	55	46	"
10	"	.70	55	46	"	"	.75	52	44	"
12	W.S.W. 3	.70	54	45	"	"	.70	54	43	"

July 25. At noon 56° 48′ 51° 56′ by obs'n.
56 31 51 43 D. R.
T. W. 44°.1; W. var. $3\frac{3}{4}$ pts.

July 26. At noon 59° 02′ 52° 23′ by obs'n.
59 02 52 21 D. R.
T. W. 44°.0; W. var. $4\frac{1}{2}$ pts.

Hour	July 27. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	July 28. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	S. W. 6	- -	- -	43	*c*	- - -	- -	- -	42	*c*	July 28, 9 P. M. saw a fog-bow.
4	"	- -	- -	43	"	- - -	- -	- -	43	"	
6	S. W. 7	- -	- -	45.5	"	- - -	- -	- -	41	*m*	
8	S. W. 8	- -	- -	45	"	- - -	- -	- -	41	"	
10	S. W. 7	- -	- -	45.5	"	- - -	- -	- -	- -	*c*	
Noon	S. W. 7	- -	- -	45	"	- - -	- -	- -	- -	"	
2	W. S. W.	29.40	70	45.5	"	S. W. 2	29.80	50	44	"	
4	- - -	.45	70	43	"	- - -	.80	49	46	"	
6	- - -	.50	65	42	"	- - -	.80	49	45	"	
8	- - -	- -	- -	43	"	- - -	.85	45	43	*m*	
10	- - -	- -	- -	43.5	"	W. 2	.85	42	42	"	
12	- - -	- -	- -	44	"	- - -	- -	- -	- -	"	

July 27. At noon 61° 41′ 52° 39′ by D. R.
T. W. 42°.0; W. var. 5 pts.

July 28. At noon 62° 28′ 52° 38′ by obs'n.
62 52 52 37 D. R.
T. W. 41°.4; W. var. 5 pts.

	July 29.					July 30.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	- - -	- -	- -	37°	*m*	S. S. W. 8	29in.35	63	34	*r*
4	W. 1	- -	- -	37.5	"	"	.30	64	34	"
6	- - -	- -	- -	35.5	"	S. S. W. 6	- -	- -	- -	"
8	- - -	29in.75	53°	36.5	"	S. S. W. 5	.40	68	37	*m*
10	- - -	.70	51	36.5	"	S. S. W. 3	.40	55	37	*c*
Noon	- - -	.60	42	37	"	"	.30	57	38	*h*
2	S. 1	.50	60	36	"	W.S.W. 4	.50	58	42	*m*
4	S. 2	.50	60	36	"	- - -	.45	55	40	"
6	S. 3	.50	66	35	"	- - -	.50	70	38	"
8	S. 4	.55	66	35	"	- - -	.55	70	37	*c*
10	"	.55	65	35	*r*	- - -	.55	50	38	*h*
12	S. 6	.40	63	35	"	- - -	.55	50	38	"

July 29. At noon 63° 35′ 53° 00 by obs'n.
63 31 52 45 D. R.
T. W. 34°.6; W. var. $5\frac{1}{4}$ pts.

July 30. At noon 65° 38′ 55° 00′ by obs'n.
65 16 54 34 D. R.
T. W. 39°.0; W. var. $5\frac{1}{2}$ pts.

July 29, 10 A. M. Passed an iceberg towards S. E., distant $1\frac{1}{2}$ mile.

6 P. M. Saw a fog bow, colors of the spectrum easily distinguished; passed several icebergs.

	July 31.					Aug. 1.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	- - -	29.60	50	39	*m*	W.S.W. 4	- -	- -	38	*h*
4	- - -	.60	50	39	"	"	- -	- -	37	"
6	- - -	.55	63	39	"	W.S.W. 5	- -	- -	37	*f*
8	- - -	.50	60	39	"	"	29.50	60	37	"
10	W.S.W. 3	.40	60	39	"	W.S.W. 6	.40	60	35	*m*
Noon	"	.50	58	39	"	W.S.W. 5	- -	- -	37	"
2	"	.30	65	37	*h r*	W.S.W. 4	.80	65	41	*c*
4	"	.40	67	38	"	W.S.W. 2	.75	- -	40	"
6	"	.50	68	37	"	W.S.W. 1	.80	- -	38	"
8	"	- -	- -	36	"	"	.80	- -	37	"
10	"	- -	- -	- -	"	"	.90	- -	36	"
12	"	- -	- -	38.5	*h*	"	.90	- -	36	"

July 31. At noon 68° 4′ 55° 25′ by obs'n.
68 1 55 4 D. R.
T. W. 37°.7; W. var. $6\frac{1}{2}$ pts.

Aug. 1. At noon 70° 10′ 54° 57′ by obs'n.
70 07 54 58 D. R.
T. W. 37°.0.

July 31, 9 A. M. Saw several whales; at 10 P. M., saw southern shore of Disco Island.

Aug. 1, 10 A. M. Off west coast of Disco opposite Nord Fiord.

	Aug. 2.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	calm	- -	- -	- -	*c*
4	"	- -	- -	- -	"
6	"	29.90	70	38	"
8	"	.95	70	38	"
10	W.S.W. 2	30.00	70	39	"
Noon	W.S.W. 1	.00	55	38	"
2	calm and	- -	- -	- -	- -
4	light	- -	- -	- -	- -
6	winds	- -	- -	- -	- -
8	"	- -	- -	- -	- -
10	"	- -	- -	- -	- -
12	"	- -	- -	- -	- -

At noon 71° 17′.5 by obs'n.
71 01 55° 10 D. R.
T. W. 36°.8; W. var. 7 pts.

Aug. 2, 6 A. M. A great number of icebergs coming out of Omenak Fiord to the E. and N.

P. M. Stood along the coast off Swartehook peninsula.

August 3. Off Swarte-hook; calm and light airs.

August 4. Near Kingatak Island; calm and light airs.

August 5, noon. Light breeze from N. W.; took pilot on board, and entered Pröven at midnight.

August 12, 4 A. M. Got under way; towed out of harbor. At 7 A. M. the carpenter found dead in his bunk. Wind N. W. (true), force 1 to 4 between 4 and noon; force 4 to 3 between noon and midnight. 6 P. M. Passed between the outer islands and sighted Upernavik Island. At 8 P. M. took pilot on board, and entered Danish Harbor at 10 P. M. Buried the body of the carpenter, the Danish priest officiating.

August 16, noon to 5 P. M.. N. N. E. wind, force 2 to 1; calm till 9 A. M. of the 17th. Got under way at 4½ P. M.; at 5 dropped anchor on account of southerly current.

August 17. Got under way at 7 A. M., with a light northerly air. Calm from 4 P. M. till noon next day.

August 18, 19. Calm. Most of the time at anchor west of Kingitok Island. On the morning of

August 20, commenced warping from iceberg to iceberg; towed the vessel for 4 miles; at 2 P. M. a N. W. wind rose; beat between the islands up to Tessusak.

August 21, 7 A. M. Reached Tessusak Harbor; moored vessel at the mouth of Little Harbor.

August 22. Got under way at 4 P. M.

August 23. At 4 A. M. abreast of Horses Head, distant 5 miles. Wind S. W., force 4 between 4 A. M. and noon. At noon 8 miles west of Devil's Thumb; wind S. W. and W., force 4 to 2 between noon and midnight.

	August 24.					August 25.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	W. 1	29in.90	45°	32°	--	N.N.E. 3	--	--	--	--
4	S. W. 1	--	--	--	--	"	--	--	--	--
6	S. W. 3	--	--	--	--	"	30in.00	38°	27°	--
8	W.S.W. 3	.90	45	32	*b*	"	.10	54	30	*o*
10	W. 3	30.00	65	31.5	"	"	.10	53	31	*c m*
Noon	"	.00	63	32	*c*	"	.20	54	30	"
2	"	.00	67	31.5	*s*	N.N.E. 2	.10	55	29	"
4	"	.00	61	31.5	*b*	S. E. 3	.10	70	28.5	"
6	N.N.W. 4	.00	63	31.5	"	S. E. 5	.10	--	29.5	"
8	N. 3	.00	63	32	"	S. E. 7	.00	55	30	"
10	"	.00	63	30	"	S. E. 8	29.80	49	30	"
12	"	.00	63	28	--	"	--	--	--	--

August 24: At noon 75° 22′ 60° 40′ by obs'n.
75 32 60 18 D. R.
T. W. 34°.0.

August 25: At noon 75° 53′ 67° 39′ by D. R.
T. W. 32°.4.

	August 26.					August 27.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	S. E. 8	--	--	--	--	S. E. 2	--	--	--	--
4	"	--	--	30	--	"	--	--	--	--
6	S. E. 7	29.70	46	31	--	N.N.E. 1	--	--	--	--
8	"	.70	46	31	*h*	N.N.E. 3	29.80	53	30	*c*
10	S. E. 6	.70	50	31	*s m*	"	.80	60	30	*s*
Noon	"	.70	49	32.5	"	N.N.E. 1	.80	60	32	*b*
2	S. E. 5	.70	49	31	"	calm	.80	60	31	"
4	S. E. 4	.70	45	31	*s*	"	.80	58	31	"
6	S. E. 2	.70	43	31	"	"	.80	53	31	"
8	"	.80	63	31	"	N. E. 8	.80	60	30	--
10	"	.80	75	32	"	"	.80	58	28	--
12	"	--	--	--	--	"	--	--	--	--

August 26: Temp. W. 32°.1

August 27: Temp. W. 32°.8.

Aug. 24. Much ice in sight. 6 P. M. Cape Walker bears N. E. by E., and the Peaked Hill N. by W.

Aug. 25, noon. Sailing through small pieces of floe ice towards Cape York; hove to close under it; sent boat ashore and brought off Hans and family. At 6 P. M. got under way; stood close along the land, sailing through small pieces of floe ice.

Aug. 26, 2 A. M. Passed Wolstenholm Island; passed Cape Perry at 9 A. M. Wind moderated; thick, with snow storm. 2 P.M. Passed Hakluyt Island: wind heavy; snow storm; no land in sight; pack to the north.

Aug. 27, 7 A. M. Cleared off, heading towards the land north of Cape Saumarez, distant 12 miles. Tacked ship, stood along the land; Cape Alexander and Sutherland Island in sight. 3 P. M. Towed the ship towards Cape Alexander. 7 P. M. A heavy gale from N. E. sprung up suddenly; hove to near pack at 10 P. M.

Hour	August 28. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather	August 29. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather
2	N. E. 8	--	--	--	--	N. E. 8	--	--	--	--
4	"	--	--	--	--	"	--	--	--	--
6	"	--	--	--	b	"	--	--	--	--
8	"	29°.70	58	31	"	N. E. 7	29.70	62	32	--
10	"	.70	48	31	"	N. E. 6	.60	56	33	b
Noon	"	.80	60	31	"	N. E. 7	.60	60	32.[illegible]	"
2	"	.80	65	31	"	squally	.60	54	31	"
4	"	.80	63	30	"	from calms	.60	70	32	"
6	"	.80	60	28	"	to heavy	.60	64	30	"
8	"	.70	61	28	"	gales	.60	70	32	"
10	"	.70	61	28	--		.66	[illegible]	31	"
12	"				--		--	--	--	--
	T. W. 32°.7.					T. W. 32°.9				

Aug. [illegible] 4 A. M. [illegible] Much [illegible] Aug. 29, A noon [illegible] way between Cape S[illegible] and Sutherland Island.

Hour	August 30. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather	August 31. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather
2	squally	--	--	--	--	N. E. 8	--	--	--	--
4	"	--	--	--	--	"	29.70	--	26	--
6	"	--	--	--	--	N. E. 7		--	--	--
8	"	29.70	55	30	--	"	.75	57	23.5	--
10	"	.70	63	30	--	"	.80	63	23.5	b c
Noon	"	.70	65	30	--	"	.80	65	23.5	b
2	N. E. 2	.70	61	30	--	"	.80	67	24	"
4	N. E. 3	.70	60	31	--	"	.80	70	24.5	"
6	N. E. 6	.70	50	31	--	"	.80	62	24	"
8	N. E. 8	.70	--	29	--	"	.80	69	24	"
10	"	.70	--	27.5	--	"	.80	69	24	"
12	"	--	--		--	---			19	--
	T. W. 33°.0.					T. W. 31°.0.				

Aug. 30, 3? A. M. Dropped anchor in 4 fathoms north end of Lat[illegible] Bay N. of Cape Saumarez.
Aug. 31, 2 A. M. Vessel commenced dragging her anchor, got under way; rounded Cape Alexander at 6½ A. M., made the pack at 10 A.M., about 14 miles N. W. by W. from the Cape, stood for Crystal Palace Cliffs.

Record of the weather during September, 1860.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
4	b c	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
6	"	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
8	"	m	. . .	b	. . .	. . .	b	. . .	. . .	b
10	"	"	. . .	. . .	. . .	. . .	"	. . .	. . .	"
Noon	"	"	. . .	. . .	. . .	f	"	. . .	. . .	"
2	"	b m	. . .	. . .	. . .	f s	"	. . .	. . .	"
4	"	. . .	. . .	. . .	. . .	"	"	. . .	. . .	"
6	b	. . .	. . .	. . .	. . .	"	"	. . .	b c	"
8	"	. . .	. . .	. . .	. . .	"	"	. . .	b q	"
10	b m	. . .	. . .	. . .	. . .	. . .	"	. . .	. . .	b c
12	"	. . .	. . .	b m	. . .	. . .	. . .	. . .	. . .	. . .
Temp of water.	29°.0	29°.0	29°.0	29°.0	29°.0	30°.0	30°.0	30°.0	30°.0	30°.0

Hour	11th	12	13	14	15	16	17	18	19	20th
2	. . .	o	b	. . .	. . .	. . .	c	b	b	b
4	. . .	"	b q	. . .	b	o	o	"	"	"
6	s m	"	"	. . .	"	"	o q	"	"	"
8	"	b c	"	. . .	"	"	b c	b m r q	"	"
10	"	"	"	b c q	b c	c	b	"	"	"
Noon	"	b c q	"	"	"	"	"	o	"	"
2	"	"	"	b q	"	"	"	b c	"	"
4	"	b c	"	"	"	"	"	"	"	"
6	o	"	"	"	b	"	"	b	"	b c f
8	"	"	"	b m	o	"	"	"	"	o
10	"	"	b	b	m	"	"	"	"	"
12	"	"	"	b m	"	"	"	b m	"	"

Hour	21st	22	23	24	25	26	27	28	29	30th
2	c	o	c	b q	o	. . .	. . .	s	b	b
4	o	"	"	"	"	o	. . .	"	"	"
6	"	"	"	"	b	"	. . .	b	"	"
8	s	c q	c m	"	. . .	"	s	o	"	b m
10	"	o	b q	"	. . .	"	. . .	o z	o	"
Noon	o	b c	"	o	. . .	"	. . .	"	"	b
2	"	"	"	"	b	"	. . .	"	b m	"
4	"	b	"	b c	o	"	s	"	"	"
6	"	b c	"	b	. . .	"	"	"	b c m	"
8	"	b	"	"	c	o s	. . .	o z q	b m	"
10	"	"	"	c	. . .	"	. . .	"	b q	"
12	o s	m q	"	"	. . .	"	s	b	"	"

Sept. 1, 7 A. M. The gale increasing, hove to 6 miles N. W. of Cape Alexander. 6 P. M. Made sail drifting to the southward of the Cape about 10 miles. Rounded Cape Alexander again at 11 P. M.; western shore distinctly visible.

Sept. 2, noon. Entered the pack 1 mile west of Littleton Island; continued beating through pack west of island; anchored on north shore of Hartstene Bay at 4 P. M. in 7 fathoms. Sept. 3, 4, 5. At anchor.

Sept. 6, 10 A. M. Towed the vessel toward Littleton Island; stopped by ice at north end of channel between McGary and Littleton Islands. Midnight, pulled out of the pack and made sail for Hartstene Bay.

Sept. 7. Came to anchor at 3½ A. M. between island and bluff west side of winter harbor.

Sept. 8. Commenced warping at 4 P. M.

Sept. 9, 8 A. M. Warping; at 5 P. M. moored the vessel in winter quarters, head to the east.

Sept. 11. Small pancake ice on the water 6 P. M.; strong ice blink in the west at 10 P. M.

Sept. 13. α Aurigæ very bright in N. W.; no other stars visible at 10; stars of second and third magnitude visible at 12.

Sept. 14, 18. Low mist bank near western horizon.

Sept. 19, 8 P. M. Pancake ice.

Sept. 20, 6 P. M. Fog bank near western horizon.

Sept. 21, 10 A. M. Pancake ice.

Sept. 22. Ice drifting in from outside; mist bank on west horizon.

Sept. 23, 5 A. M. Ice began moving, and at 6 had disappeared.

Sept. 24, 10 P. M. Clouds in N. W. illuminated by twilight.

Sept. 27, 8 A. M. Ice formed around the vessel nearly an inch thick.

Sept. 28, 10 A. M. Ice began drifting out of the harbor; 8 P. M. Fog bank near west horizon.

Sept. 29, 30. Mist on west horizon.

Record of the weather during October, 1860.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	- - -	- - -	*o*	*s*	*c*	*o s q*	*q*	- - -	[illegible]
4	"	*b*	*b*	"	"	- - -	"	"	[illegible]	[illegible]
6	"	"	"	*s*	"	*o s*	"	"	[illegible]	[illegible]
8	"	*b c*	"	"	"	"	"	*o q*	"	*b q*
10	"	"	*b c*	"	"	"	"	"	"	*b*
Noon	"	"	*o*	"	*o*	"	"	"	*o s*	[illegible]
2	"	"	"	"	"	"	"	"	"	*b c*
4	"	"	"	"	"	"	"	*o m q*	"	"
6	"	"	*o s*	"	"	*o s*	"	"	*b s*	[illegible]
8	"	"	"	"	- - -	"	"	*o q*	"	"
10	*b c q*	"	- - -	"	- - -	"	"	"	*b q*	*b*
12	*b*	"	- - -	"	*c*	*m q*	"	"	- - -	- - -

Hour	11th	12	13	14	15	16	17	18	19	20th
2	- - -	- - -	- - -	- - -	- - -	*b*	- - -	*b*	*b*	*b*
4	- - -	- - -	- - -	- - -	- - -	"	- - -	"	"	"
6	- - -	- - -	- - -	- - -	- - -	"	- - -	"	"	"
8	- - -	*o*	*o q*	*b c q*	*b*	"	*b c*	*b c*	"	"
10	*b c*	*o s*	"	*b c*	"	"	- - -	"	"	"
Noon	"	"	"	*b*	"	"	- - -	*b*	"	"
2	"	"	"	"	"	"	- - -	"	"	"
4	*b*	"	*b c*	"	*b c*	"	- - -	"	"	"
6	"	"	"	"	"	"	*b c*	"	"	"
8	"	*o*	"	"	*o*	"	*b*	"	"	"
10	"	*b c*	- - -	"	"	"	"	"	"	"
12	"		- - -	"	*b*	"	"	- - -	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2	*b*	*o*	*b*	*b*	*b*	*b*	- - -	*b*	*o q*	*o*	*b*
4	"	"	*o*	"	"	"	*b*	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"	"
8	"	"	- - -	"	*b c*	*b c*	*b c*	"	"	"	*s o*
10	"	"	*b c*	*b c*	"	"	"	"	"	*o s*	*o*
Noon	"	"	"	"	"	"	"	*b c*	"	"	"
2	"	"	*b*	"	*o*	"	"	"	"	"	"
4	*o*	*b c*	"	"	*o s*	"	"	"	"	*o*	"
6	"	"	"	"	"	"	"	"	"	"	*b*
8	"	*b*	"	*b*	*o*	"	*b*	*b*	"	"	"
10	"	"	"	"	"	*b*	"	"	"	"	"
12	*o s*	"	"	"	*b*	- - -	"	"	"	"	"

October 2. At noon ice forming upon the surface of the water.
October 8, 4 P. M. Heavy mist bank on S. W. horizon.
October 12, noon to 6 P. M. Snow 6½ inches deep.

Record of the weather during November, 1860.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*o*	*b*	*b*	...	*b*	*b*	*s*	*b*	*o s*
4	"	*b*	"	"	...	"	"	*o*	*o*	"
6	"	"	"	*o*	...	"	"	"	"	"
8	"	*b c*	*b c*	"	*b c*	"	*o*	*o s*	"	"
10	*b c*	"	"	"	"	"	"	*b c*	"	"
Noon	"	"	*o*	"	"	"	"	*o*	"	"
2	"	"	"	"	*b*	*b c*	"	"	"	"
4	"	*o*	"	"	"	"	"	"	"	"
6	"	"	"	"	"	*b*	"	"	*o s*	"
8	"	*b*	*b*	"	"	"	*o s*	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	"	"	*b*	"	*o*	...	*b*	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*b*	*o*	*o*	*b*	*b*	*b*	*b*	*b*	*b*	*b*
4	"	"	"	"	"	"	"	...	"	"
6	"	"	"	"	"	"	"	...	"	"
8	*o s*	"	*b c*	"	"	"	*o s*	*b*	"	"
10	"	"	"	*o*	"	"	"	"	"	"
Noon	"	"	"	*b c*	"	*b c*	"	"	"	"
2	"	"	"	*o*	"	"	*o*	"	"	"
4	"	"	"	"	*o*	"	"	"	"	*o*
6	"	"	"	*b*	"	*b*	"	"	"	"
8	*o*	"	"	"	*b c*	"	"	"	"	"
10	"	"	"	"	"	"	*b*	"	"	"
12	...	"	"	"	*b*	"	"	...	"	"

Hour	21st	22	23	24	25	26	27	28	29	30th
2	*o*	*b*	*b*	*o*	*s*	*b*	*s*	*o s*	*r s*	*s*
4	"	"	"	"	*o*	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	*b*	*o*
10	"	"	"	"	*s*	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"	*b c*	"
2	"	"	"	*o s*	*o*	"	"	*o*	"	"
4	"	"	"	*s*	"	"	*o*	*r s*	"	*s*
6	"	"	"	"	"	*b c*	"	"	"	"
8	"	"	"	"	"	*o*	"	"	"	"
10	"	"	"	"	"	"	*s*	"	"	"
12	"	"	...	"	"	"	"	"	...	*o*

Record of the weather during December

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*o*	*b*	*b*	*o*	*o*	*b*	*b*	*b*	*b*
4	. . .	"	"	"	"	"	"	"	"	"
6	*o*	"	"	"	"	"	"	"	"	"
8	*b c*	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
Noon	"	*b*	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	"	"
4	"	"	"	*o*	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	"	*o*	"	"	"	*b*	"	"	"	"
10	*o*	"	"	"	"	"	"	"	"	"
12	"	*c*	"	"	"	"	"	. . .	. . .	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*b*	*o*	*b*	*b*	*b*	*b*	*b*	*s*	*o*	*s*
4	"	"	"	"	"	"	*o*	"	"	"
6	"	"	"	"	"	"	*o s*	"	"	"
8	*o*	*b*	"	"	"	"	"	"	"	*b*
10	"	"	"	"	"	"	"	"	"	*o*
Noon	"	"	"	"	"	"	"	"	*b c*	"
2	"	"	"	"	"	"	"	"	"	"
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	*b*	"	"
8	"	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	. . .	"	*s*	*s*

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2	. . .	*b*	*o*	*o*	*b*	*b*	*b*	*b*	*b*	*b*	*b*
4	*b*	"	"	*b*	"	"	"	"	"	"	"
6	"	"	*s*	"	"	. . .	"	"	"	"	"
8	*o*	"	"	"	"	. . .	"	"	"	"	"
10	"	"	"	"	"	. . .	"	"	"	"	"
Noon	"	"	"	"	"	. . .	"	"	"	"	"
2	"	"	. . .	"	"	*b c*	"	"	"	"	"
4	"	"	. . .	"	. . .	"	. . .	"	"	"	"
6	"	"	. . .	"	. . .	"	. . .	"	"	"	"
8	*b*	"	. . .	"	. . .	"	. . .	"	"	"	"
10	"	*o*	*o*	"	. . .	. . .	. . .	"	"	"	"
12	"	"	*s*	"	*b*	*b*	*b*	"	"	"	"

Record of the weather during January, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*b*	*b*	*b*	*s*	*b*	*b*	*b*	*b*	*b*
4	"	"	"	"	*b*	"	"	*s*	"	"
6	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	"	"
10	"	*b c*	"	"	"	"	"	*b*	"	"
Noon	"	"	"	"	"	"	"	"	"	*b c*
2	"	*o*	"	"	"	"	"	*b m*	"	*b m*
4	"	"	"	"	"	"	"	*b*	"	*b c*
6	"	"	"	"	"	"	"	"	"	*o*
8	"	"	"	"	"	"	"	"	"	*o m*
10	"	"	"	"	"	"	"	"	"	*s*
12	"	*b*	"	*s*	"	"	"	"	"	*m s*

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*s*	*b*	*b*	*s*	*b*	*b*	*b*	*b*	*b*	*b*
4	"	"	"	"	"	"	"	"	"	"
6	"	"	*z*	"	"	"	"	"	"	"
8	"	"	"	*m*	"	"	"	"	"	*z*
10	"	"	*z q*	*b*	"	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"	*b c*	"
2	*o*	"	"	"	"	"	"	"	*z*	"
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	"	"
10	"	"	*s*	"	"	"	"	"	"	"
12	*b*	"	"	"	"	"	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2	*b*	*b*	*b*	*b*	*b*	*b*	*m*	*m*	*o s*	*b*	*b*
4	"	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"	"
8	"	"	"	*b m*	"	"	"	"	*o*	"	"
10	"	"	"	*b*	"	"	*s m*	"	*b c*	"	"
Noon	"	"	"	"	"	"	"	"	"	*b m*	"
2	"	"	"	"	"	"	"	*m*	"	"	"
4	"	"	"	"	"	*o*	*o*	*m*	*b*	*b*	"
6	"	"	"	"	"	"	"	*b*	"	"	*o*
8	"	"	"	"	"	"	*b*	"	"	"	*b*
10	"	"	"	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	"	"	"	"	"

January 5, 6. Aurora (see magnetic paper).
January 10, 8 P. M. Heavy mist hanging over the ice.
January 11. Heavy mist over the ice. Auroral display (see magnetic record).
January 25. At noon read without an artificial light.
January 28, 2 P. M. Heavy mist bank on S. W. horizon.
January 30, noon to 2 P. M. Heavy mist in S. W.

Record of the weather during February, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*s*	*b*	*b*	*b*	*b*	*b*	*b*	*s*	*b*
4	"	*b*	"	"	"	"	"	"	*b*	"
6	"	"	"	"	"	"	"	"	"	"
8	"	*s*	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
Noon	"	"	"	"	"	"	"	"	*z*	"
2	"	*o*	*b c*	"	"	"	"	"	"	"
4	*o*	"	*m*	"	"	"	"	"	"	"
6	*s*	"	*b*	"	"	"	"	"	"	"
8	"	*b*	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	*s*
12	"	"	"	"	"	"	"	*s*	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*o*	*o s*	*b*	*z*	*b*	*b*	*b*	*b*	*b*	*b*
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	*s*	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
Noon	"	"	"	"	"	"	- - -	"	"	"
2	"	"	"	"	"	"	*s*	"	"	"
4	"	"	"	"	"	"	"	"	"	"
6	"	*b*	*z*	"	"	"	"	"	"	"
8	*z*	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	*b*	"	"	"

Hour	21st	22	23	24	25	26	27	28th
2	*b*	- - -	*b*	*z*	*b*	*b*	*b*	*b*
4	"	*b*	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"
8	"	*s*	"	"	"	"	"	"
10	"	*o*	"	"	"	"	"	"
Noon	*b c*	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"
4	*o*	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"
12	*b*	*s*	"	"	"	"	"	"

February 16, 9 P. M. An aurora visible.
February 18. Sun seen above the horizon.
February 19. Mock moon observed at 4 A. M., one image on either side of the moon about 20° distant.
February 25, 2 P. M. Sun shining on deck.

Record of the weather during March, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*b*	*s*	*b*	*b*	*b*	*b*	*b*	*o*	*b*
4	"	"	*o*	"	"	"	"	"	*b*	"
6	"	"	*b*	"	"	"	"	"	- - -	"
8	"	*o*	*o*	"	"	"	"	*o*	*b c*	"
10	"	"	"	"	*b c*	"	"	"	"	*b c*
Noon	*b c*	"	"	"	"	"	"	"	*b*	*o*
2	*c*	*o s*	"	"	"	"	"	"	"	*s*
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	*b*	"	*b c*
8	*c s*	"	"	"	"	"	"	"	"	*s*
10	"	"	"	"	*b*	"	"	"	"	"
12	*b*	"	"	"	"	"	"	"	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*s*	*s*	*b*	*b*	*b*	*b*	*b*	*b*	*b*	*b*
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	*c*	*b*	"	"	"	"	"	"	"	"
10	"	"	"	"	*b c*	"	"	"	"	"
Noon	*b*	"	"	*z*	"	"	"	"	"	"
2	"	"	"	"	*b*	"	"	"	"	"
4	*s c*	"	"	"	"	"	"	"	"	"
6	*s*	*z*	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	"	"
10	"	- - -	"	"	"	"	"	"	"	"
12	"	*b*	"	*b*	"	"	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2	*b*	*b*	*b*	*b*	*o*	*b*	*b*	*s*	- - -	*b*	*b*
4	"	"	"	"	*s*	"	"	"	*c*	"	"
6	"	"	"	"	"	"	"	"	*b*	"	"
8	"	*b c*	"	"	"	"	*o*	*z*	"	*c z*	*b c*
10	"	"	"	"	"	"	"	"	"	"	*c*
Noon	"	"	"	"	"	"	"	"	"	*b z*	"
2	"	"	"	"	"	"	"	"	*z*	*c*	"
4	"	"	*b c*	"	"	"	"	*o*	*z b*	*o*	*o*
6	"	"	*b*	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	*z c*	"	"
10	"	"	"	"	"	"	"	"	"	*c*	"
12	"	"	"	*o*	"	"	*s*	*b*	- - -	*b*	*b*

March 31. Read at midnight without artificial light.

Record of the weather during April, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*b*	*b*	*b*	*z q*	*c*	*b c*	*b*	*c*	*b*
4	"	"	"	"	"	*s o*	- - -	"	"	"
6	"	- - -	"	"	"	"	- - -	"	"	"
8	"	*o*	"	"	*b q*	"		"	*c*	"
10	"	"	"	"	*c q*	*o*	"	"	"	"
Noon	*c*	"	"	"	"	"	"	*c*	"	*b*
2	"	"	"	"	"	"	"	"	"	*c*
4	*o*	"	"	"	"	"	*b*	"	"	"
6	"	"	"	"	"	"	"	*o*	"	"
8	*c*	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	*b*	*s*	"	*c*	"	"	"	"	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*o*	*b*	*b*	*z*	*b*	*b*	*b*	*c*	*b*	*b*
4	"	"	*c*	"	"	"	"	*b*	"	"
6	"	"	"	"	"	"	"	"	"	"
8	*z*	*o*	*m*	"	"	"	[illegible]	"	*m*	*c*
10	"	*s*	"	"	"	"	- - -	"	"	"
Noon	"	"	"	*b*	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	"	"
4	"	*b c*	*o*	"	"	"	"	"	"	"
6	"	*o*	*z*	"	"	"	"	"	"	"
8	"	"	"	"	"	"	*s*	"	"	"
10	"	*b*	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30th
2	*o s q*	*z*	*b*	*s*	*s*	*b*	*b*	*b*	*b*	*b*
4	"	*o*	"	"	"	"	"	"	*c*	"
6	"	"	"	"	"	"	"	"	"	*c*
8	"	"	"	"	*b*	"	"	"	*z*	"
10	"	*c*	"	"	*z*	"	"	"	"	"
Noon	"	*b*	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	*c*	"
4	"	"	*o*	"	"	"	"	*c*	"	"
6	"	"	*s*	"	*c*	*c*	"	"	"	"
8	"	*c*	"	"	"	"	"	"	"	"
10	"	"	*o*	"	"	*o*	"	"	"	"
12	"	*b*	*s*	"	*b*	"	"	"		"

April 18. At noon snow melting on side of ship.

Record of the weather during May, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*b*	*b*	*b*	*o*	*b*	*b*	*o*	*s*	*b*
4	"	"	*o*	*s*	"	"	"	"	"	"
6	"	"	"	"	"	"	"	*s*	*o*	"
8	"	"	"	"	*b*	"	"	"	"	"
10	"	"	*b*	"	"	"	"	"	*b*	"
Noon	"	*c*	"	"	"	"	"	"	"	"
2	"	"	"	"	"	"	"	"	"	"
4	"	"	"	"	"	*c*	"	"	"	"
6	"	*b*	"	"	"	*b*	"	"	"	"
8	"	"	"	*o*	"	"	*o*	"	"	"
10	"	"	"	"	"	"	"	"	"	"
12	"	*c*	"	"	"	"	"	"	"	"

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*b*	*b*	*b*	*b*	*b*	*b*	*o*	*b*	*o*	*b*
4	"	"	"	"	"	*o*	"	"	"	"
6	"	"	"	"	"	"	*s*	"	*s*	"
8	"	"	"	"	"	"	*s m*	*o s*	"	"
10	"	"	"	"	"	"	"	"	*b*	"
Noon	"	"	"	"	"	"	"	"	"	"
2	"	"	"	"	*o*	"	"	"	- - -	"
4	"	"	"	"	*b*	*m*	*c*	*o s m*	*c*	"
6	"	"	*c*	"	"	"	"	"	*b*	"
8	"	"	"	"	*c*	*m s*	"	"	"	"
10	"	"	"	"	*o*	- - -	"	"	"	*c*
12	"	"	*b*	"	*b*	*o*	*o*	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2	*b*	*o*	*b*	*b*	*b*	*b*	*o*	- - -	*b*	*b*	*b q*
4	"	"	"	"	"	"	"	- - -	"	"	*s q*
6	*o*	*b*	"	"	"	"	"	- - -	"	"	*b q*
8	"	*c*	"	"	"	"	"	*c*	"	"	"
10	"	*b*	"	"	"	"	"	"	"	"	"
Noon	*s*	"	"	"	"	"	*c*	*s*	"	"	"
2	*o*	"	"	"	"	"	"	*o*	"	"	"
4	"	"	"	"	"	"	"	*c*	"	*c s*	"
6	"	"	"	"	"	"	"	"	"	*c s q*	"
8	"	"	"	"	"	"	*b*	"	"	"	"
10	"	*c*	"	"	"	*c*	"	*b*	"	*o s q*	*c s q*
12	"	"	"	"	"	"	"	"	"	- - -	*q*

May 12. Water running down the hills.
May 16, 4 and 6 P. M. Thick mist over the hills and over the ice.
May 17, 8 A. M. to 2 P. M., and 18, 4 P. M. to midnight. Mist bank in S. W

Record of the weather during June, 1861

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*b*	*b*	*o*	*s*	*o*	*b*	*o*	*b*	*b*	*b*
4	"	"	"	"	*s*	"	"	"	"	"
6	"	"	"	- - -	*m*	"	*b*	"	"	"
8	"	*c*	"	- - -	"	- -	"	"	"	"
10	*c*	"	"	*o*	"	*c*	"	"	*c*	"
Noon	"	"	"	"	*o*	"	"	"	"	"
2	"	*o*	"	"	*c*	"	"	"	"	"
4	"	"	"	"	*b c*	"	"	"	"	"
6	"	"	"	"	*b*	"	"	"	"	"
8	*s*	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	*b*	"	*c*	"	"
12	*b*	"	*o s*	*b*	"	"	"	"	"	*o*

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*o*	*o*	*b*	*b*	*b*	- - -	*s q*	*s q*	*o*	*o*
4	"	"	"	"	"	- - -	"	"	"	"
6	"	"	"	"	"	- - -	"	"	"	*b*
8	*s*	"	"	"	"	*s q*	- - -	"	*s*	*b c*
10	*o*	"	"	*c*	"	"	*c q*	"	"	"
Noon	"	"	*c*	"	"	"	"	"	"	*b*
2	"	*s*	"	"	"	"	"	"	*o*	"
4	"	*c s*	*c s*	"	"	"	"	"	"	"
6	"	"	"	"	"	"	"	"	"	"
8	"	*c q*	*b*	*b*	"	"	"	"	"	"
10	"	- - -	"	"	"	"	*s q*	"	"	"
12	"	*s*	"	"	"	*q o*	"	"	*q*	*c*

Hour	21st	22	23	24	25	26	27	28	29	30th
2	*b*	*b*	*o*	*b*	*o*	*r*	*r*	*s*	*b*	*s*
4	"	"	"	"	"	"	"	"	"	"
6	"	"	"	*c*	"	"	"	"	*c*	"
8	"	*c*	"	- - -	"	"	"	"	"	"
10	"	"	"	*o*	*r*	"	"	"	*o m*	*r*
Noon	"	"	"	"	"	"	"	"	*r*	- - -
2	"	*o*	"	"	"	"	"	*o*	"	*o m*
4	"	*c*	"	"	"	"	*o*	*r*	*s*	"
6	"	- - -	"	"	"	"	*r*	*o*	"	*f*
8	"	*b*	*c*	"	"	*o*	*s*	"	"	"
10	*c*	*c*	"	"	"	- - -	"	"	"	*r*
12	- - -	"	*o*	"	*r q*	*r q*	"	*b*	"	*o*

June 28. Amount of rain and snow in 48 hours was found to be 0.44 of an inch.
June 30. Amount of rain and snow fallen in 22 hours was found to be 0.25 of an inch.

Record of the weather during July, 1861.

Hour	1st	2	3	4	5	6	7	8	9	10th
2	*m*	*o s*	- - -	*b*	*s*	*b*	*b*	*b*	*c*	*b*
4	*r*	"	*o*	"	"	"	"	"	"	"
6	- - -	"	"	*c*	*b*	"	"	"	"	"
8	*o*	"	"	"	"	*c*	"	*c*	*b*	*o q*
10	"	"	"	"	*c*	"	"	- - -	"	*c q*
Noon	"	"	*b*	"	"	*b*	*f*	- - -	"	"
2	"	"	"	"	"	"	*b*	*o*	"	"
4	"	"	"	*s*	*o*	"	"	*r*	"	*o*
6	"	"	"	"	"	"	"	*o*	"	"
8	"	"	"	"	"	"	"	"	"	"
10	*c*	"	*c*	"	*c*	"	"	"	"	"
12	"	"	- - -	"	*b*	"	"	*c*	"	*b*

Hour	11th	12	13	14	15	16	17	18	19	20th
2	*b*	*b*	*s*	*b*	*c*	*c*	*c*	*r*	*c*	*c*
4	"	"	"	"	*b*	"	"	"	*r*	*b c*
6	*o*	"	"	"	"	"	"	*c*	"	"
8	"	"	"	"	"	"	"	"	"	"
10	"	"	- - -	"	"	"	"	"	"	"
Noon	"	"	*o*	"	"	"	"	"	*c*	*c*
2	*c*	"	*c*	"	"	*s*	"	"	*r*	"
4	"	"	"	"	"	"	"	"	*c*	*r*
6	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	"	*c*	"	"	"	*f*
10	"	"	"	*c*	*c*	*r*	"	"	"	*c*
12	*b*	"	"	"	"	*c*	"	"	"	"

Hour	21st	22	23	24	25	26	27	28	29	30	31st
2	*r*	*f*	*s*	*c*	*s*	*c*	*b*	*b*	*b*	*b*	*f*
4	*c*	"	"	"	"	"	*f*	"	"	"	"
6	*r*	*b*	"	"	"	*r*	"	"	"	"	"
8	*s*	"	*o*	"	"	"	*b*	"	"	"	*c*
10	"	"	"	"	"	*c*	"	"	"	"	"
Noon	"	*c*	*s*	"	"	"	"	"	"	"	"
2	*o*	*s*	- - -	"	"	"	"	"	"	*c*	*f*
4	"	"	*c*	"	*r*	"	"	"	"	"	"
6	*r*	"	"	*s*	*c*	"	"	"	"	"	*o*
8	"	*c*	"	*o*	"	*b*	"	"	"	*f*	"
10	*o*	"	"	"	"	"	"	*c*	"	"	*f*
12	"	*s*	"	*s*	"	"	"	*b*	"	"	"
Temp. of water.							32°.4	35°.1	33°.8	35°.1	35°.7

July 14, 10 A. M. Unmoored ship and pulled out of Port Foulke. 7 P. M. Made fast to an iceberg one mile south of Port Foulke.

July 15. Got under way at $1^h\,30^m$ P. M.; made the open water at $2^h\,25^m$; stood towards Cape Isabella; a thick fog coming on, moored in 3 fathoms water in channel between McGary and Littleton Islands.

July 27, 10½ A. M. Got under way and stood towards the west coast; observed latitude 78° 22′ N. among the floe ice off Cape Isabella. At 5½ P. M. (Green. time), in a line with Capes Ingersoll and Inglefield.

July 28, 3 A. M. Made fast to an iceberg. 6 A. M. Heading for first point south of Cape Isabella. 10 A. M. Let go anchor, half a mile from shore, in a large bay ten miles south of Cape Isabella, in 9 fathoms water. New ice on surface of water.

July 29, 1 P. M. Up anchor and pulled through ice to the southward. At 3½ becalmed; fastened to an iceberg off Gale Point. 8 P. M. Cast off and commenced warping from floe to floe. 10 P. M. Many narwhals and seals in the vicinity of the schooner. At midnight opposite Paget Point met heavy pack ice; kept along the margin of it.

July 30, 6 A. M. Mattie Island bears W. by S.; Cape Faraday N. W. by W.; Gale Point N. by E. 7 P. M. Shut in with a thick fog; tacked ship, head to S. W. 11 P. M. Fell in with the pack stretching E. and W.; wore ship to S. E.

July 31. Wore ship to N. at 10 A. M., Northumberland Island bears S. E.

	August 1, 1861.					August 2				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	E. S. E.	29in.90	46°	32°	f	calm	29in.92	47	39	b
4	"	.80	45	33	b	E. N. E. 1	.92	49	45.5	"
6	E. S. E. 2	.85	46.5	34.5	c	W. 1	.85	51	42	"
8	E. S. E. 2	.90	38	34	b	"	.90	53	46	"
10	E. S. E. 1	.90	48	36	"	"	.94	51	43	"
Noon	S. 1	.85	49	36	"	"	.85	--	38	"
2	N. N. E. 1	30.00	50	35	"	W. S. W. 2	.96	46	37	f
4	E. by N. 1	29.90	--	36	"	W. S. W. 1	.98	45	37	"
6	calm	.95	51	44	"	"	30.00	53	37	"
8	"	.95	51	45	"	N. N. E. 1	29.87	49	34	"
10	W.	.97	49	40	"	E. N. E. 2	.90	49	33	"
12	calm	.85	45	37.5	"	S. E. 1	.90	52	32	"
	Temp. water, 35°.6.					T. W. 36°.2.				

Aug. 1, 4 A. M. Cape Sabine N. ¾ E., Cape Isabella N. ¼ W. 6 A. M. Mittie Island N. W. by W., Cape Faraday N. W. ¼ N., Cape Isabella N. by E., Coburg Island W. S. W., high land on east coast N. E. by E.

Aug. 2, 8½ A. M. Commander went ashore; returned at 11 A. M. At 2 P. M. south part of Hakluyt Island bears S. (mag. ?). 4 P. M., south point of Northumberland Island S. by W. (mag.).

	August 3.[1]					August 4.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N. N. E. 3	29.95	52	32	h	N. E.	29.90	51.5	38.5	b
4	"	.85	50	32.5	f	"	.90	49	37	"
6	- - -	.80	53	37	"	"	.91	47.5	41.5	"
8	calm	.87	55	38	b	calm	.84	51	50.5	"
10	"	.87	56	40.5	"	- - -	.94	52	47	"
Noon	"	.90	56	39	"	- - -	.90	55	48	"
2	S. 1	.82	58	37.5	"	calm	.97	60	45	"
4	- - -	--	--	--	"	"	30.03	61	44	"
6	S. S. E. 1	.88	55	41	"	"	.00	56	51	"
8	N. E. 1	.85	53	41	"	"	29.96	52	46.5	c
10	"	.87	55	43	"	"	.98	51	47	b
12	calm	.92	53	40.5	"	"	30.00	51	40	"
	T. W. 36°.2.					T. W. 38°.9.				

Aug. 4. At anchor.

	August 5.					August 6.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N. W. 2	29.98	50	38	b	calm	29.90	55	41	b
4	N. W. 1	.90	50	37	"	N.	.85	48	35	"
6	"	30.00	51	45	"	"	.90	53	37	"
8	"	29.96	52	47	"	"	.90	--	38	"
10	"	30.00	50	45	"	"	.90	50	38.5	"
Noon	"	29.96	48	41	"	"	.97	49	47	"
2	N. E. 2	.94	48	42.5	"	calm	.97	49	48	"
4	N. E. 1	.95	49	48	"	"	.98	50	47	"
6	N. E. 3	.96	50	46	"	"	.98	50.5	49	"
8	N. E. 1	.95	50	46	"	"	.87	56	48	"
10	"	.90	53	43	"	N. E. 1	.92	56	41.8	c
12	"	.88	52	39	"	"	.90	57	41	b
	T. W. 38°.0.					T. W. 37°.2.				

[1] Remarks noted at end of month's record.

	August 7.					August 8.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	- - -	- -	- -	- -	*b*	N. E. 1	29in.91	56°	39	*c*	Aug. 8. Got under way at 10 A. M. At noon south point of Northumberland Island bears S. E. by E. ½ E., and south point of Netlik bears S. ½ W. At 2½ P.M. Cape Parry bears due E. (true) distance 1 mile; at 4½ Fitzclarence rock bears E. (three miles). 4½ P. M. Commander went ashore.
4	- - -	- -	- -	- -	- -	"	.97	56	39.5	*b*	
6	- - -	- -	- -	- -	- -	calm	.98	58	42	"	
8	calm	29in.92	54°	47°.5	*b*	N. 1	.97	58	42.5	"	
10	- - -	- -	- -	- -	- -	"	30.00	55	43	"	
Noon	calm	.95	54	41.5	*b*	"	29.98	54	43	"	
2	"	.93	53	47	"	W. 2	30.05	54	41	"	
4	N. E. 1	.95	53	42	"	W. 1	29.98	58	42	"	
6	"	.93	54	45	"	N.N.W. 1	30.02	57	46	"	
8	calm	.91	56	42	"	"	.00	- -	46	"	
10	"	.98	52	43	"	N. E.	.01	56	42	"	
12	"	.93	58	41	*c*	"	.00	55	38	"	
	T. W. 37°.9.					T. W. 37°.9.					

	August 9.					August 10.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	calm	29.90	55	39	*c*	E. S. E. 1	29.80	51	38	*b*	Aug. 9, 4 A. M. Strong current setting to westward. 8 P. M. Cape Parry bears N. by W., and southern part of Saunders Island S. E. ½ S. Aug. 10. At 0h Cape Parry N. ¼ E. south point of Wolstenholm S. E. ½ S. Fitzclarence Rock N. N. E. ¾ E.
4	"	.90	54	39.5	"	"	.75	50	40	"	
6	"	.85	53	41	*b*	S. E.	.80	51	45	"	
8	"	.90	54	48	"	"	.82	59	44.5	"	
10	"	.90	53	49	"	N. W. 3	.90	54	42.5	"	
Noon	"	.87	53	48	"	N. W. 4	.92	54	40	"	
2	"	.90	53	45	*c*	E. 6	.80	54	44	*b c*	
4	"	.95	55	47	*b*	"	.80	50	38	*c*	
6	"	.80	- -	46	"	"	.85	51	37.5	"	
8	S. 1	.87	54	42.5	"	"	.90	53	40.5	*b*	
10	W.S.W. 2	.97	55	42	*c*	"	.75	52	39	"	
12	"	.92	52	40.8	"	"	.80	51	38	"	
	T. W. 39°.0.					At noon obser'd lat. 76° 12′ Long. by chr. 70 53 Var'n, 106° W. T. W. 38°.4					

	August 11.					August 12.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	E. 6	29.82	50	39.5	*b*	N.N.E. 3	29.77	53	33	*b*	Aug. 11. At midnight horizon free of ice from N. E. to S. W. At 9½ A. M. made the pack, ran along the margin to the south; entered the ice at 10½. Aug. 12, 4 A. M. Fell in with the whaling bark "Polar Star," of Peterhead Eng.
4	"	.80	48	40	"	"	.80	52	36.5	"	
6	"	.90	47	40	"	"	.70	48	35	"	
8	"	.90	50	39	"	"	.75	49	34	*f*	
10	"	.80	50	35	"	"	.75	50	36	"	
Noon	"	.70	52	36	"	N.N.E. 1	.70	50.5	36	"	
2	N. E. 5	.82	55	37.5	"	- - -	.80	53.5	35	"	
4	"	.80	53	40	"	N. W. 1	.82	50.5	34.5	"	
6	"	.75	58	38	"	calm	.75	50	33	"	
8	N.N.E. 4	.74	60	36	"	"	.73	55	31	"	
10	"	.75	58	35	"	"	.90	50.5	31.5	"	
12	"	.75	54	32.5	"	N. by W. 1	.90	49.5	31	"	
	Obs'd lat. 74° 19 long. 66 00 at noon T. W. 35°.0.					At noon lat. by D. R. 74° 02′ long. 60 16 W. var. 7½ pts. T. W. 34°.9.					

	August 13.					August 14.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	W.S.W.1	29".80	48°	33°	f	W. 1	29".68	57°	37	o	Aug. 13. At 7½ A. M. made the land bearing N. E. by E. (Cape [illegible]) at [illegible] A. M. a small island in sight bearing N. E. by N. [illegible] (Cape [illegible]). 2 P. M. Land in sight to the eastward. Aug. 14. 11 P. M. Came to anchor in Upernavik Harbor.
4	variable	.75	48	33	"	N. E. 1	.65	56	37	"	
6	W.S.W. 1	.70	48	34	"	calm	.80	55	44.5	"	
8	"	.78	50	36	s	"	.80	57	47	"	
10	"	.70	53	38	o	"	.75	52	47	"	
Noon	"	.81	77	40	"	"	.85	54	45.5	"	
2	E. N. E. 1	.80	64	40.5	o	"	.75	56	46	b	
4	"	.88	68	39	"	"	.70	50.5	44	"	
6	E.	.78	65	39	"	N. E. 2	.70	52.5	45	"	
8	"	.77	62	39	s	"	.70	50	40.5	"	
10	variable	.75	66	37	"	"	.75	51	38	"	
12	"	.85	62	36.5	"	"	.80	50	36	"	

Lat. by obs'n, 73° 40′
Long. by chr. 58 46
W. var. 80°. T. W. 39°.4.

T. W. 40°.0

	Aug. 15.					Aug. 16.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	calm	29.85	52	35	b	N. W. 1	30.05	60	35	m
4	"	.80	52	35.5	"	"	29.95	58	36	b
6	"	.75	50	33	"	"	30.00	49	36	"
8	"	.70	50	42	"	"	29.99	55	39	"
10	"	.80	50	48	"	"	.97	57	47	"
Noon	"	--	--	52	"	"	.98	58	--	"
2	N. E. 1	.90	52	52	"	calm	.90	56	51	"
4	"	.95	50.5	50.5	"	E. N. E. 1	.50	54	50	"
6	---	.90	51	41	"	"	.80	51	50	"
8	---	30.10	60	38.5	"	"	.90	56	41.8	"
10	---	.05	60	--	"	"	.92	54	38.5	"
12	N. W. 2	.10	60	38.5	f	"	.95	52	36	"

T. W. 39°.8.

T. W. 41°.3.

	August 17.					August 18.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	E.N.E. 1	29.94	53	36.5	c	---	--	--	--	--
4	"	.95	53	36	"	E.N.E. 1	29.90	52.5	37	b
6	"	.92	53	45	"	---	--	--	--	"
8	"	.92	53	45	b	---	--	--	39	"
10	calm	.92	54	55	"	---	--	--	--	"
Noon	E. N. E. 1	.90	51.5	--	"	---	--	--	43	"
2	"	.93	55	51	"	---	--	--	--	--
4	---	--		--	"	N. W. 1	29.95	51	39.5	--
6	E. N. E. 1	.82	51.5	48	"	---	--	--	--	--
8	"	.85	51	42	"	N. W. 1	.87	52	38	--
10	---	--	--	--	"	---	--	--	--	--
12	---	--	--	32	"	N. W.	.80	53	36	--

T. W. 40°.1.

T. W. 36°.8

	August 19.					August 20.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
4	N. W.	- -	- -	36°	- -	calm	- -	- -	36	*r*
6	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
8	N. W.	29^{in}.86	50°	36	- -	calm	29^{in}.78	52	36	*r*
10	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
Noon	N. W.	.77	49	39.2	- -	calm	.76	49	38	*r*
2	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
4	calm	.82	48	44	- -	- - -	.75	50	36	- -
6	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
8	calm	.81	52.5	41	- -	- - -	- -	- -	35	- -
10	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
12	calm	- -	- -	39	- -	- - -	- -	- -	35	- -
	T. W. 38°.8.					T. W. 37°.5.				

	August 21.					August 22.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	- -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
4	- - -	- -	- -	35	- -	- - -	- -	- -	37	- -
6	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
8	- - -	29.78	55	37.5	- -	N. E. 1	29.72	52	37	- -
10	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
Noon	N. W. 1	.72	56	40	- -	N. E. 1	.68	49	41	- -
2	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
4	- - -	.69	52	40	- -	N. 1	.68	47	45	- -
6	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
8	- - -	.70	52	39	- -	N. 1	- -	- -	35	- -
10	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
12	N. W. 1	.67	54	36.5	- -	N 1	.65	40	35	- -
	T W. 38°.9.					T. W. 38°.3.				

	August 23.					August 24.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
4	N. 1	- -	- -	33	- -	N. 2	29 78	40	30	- -
6	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
8	N 1	29.70	50	41	- -	N.	.80	41	32	- -
10	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
Noon	- - -	- -	- -	- -	- -	- - -	- -	- -	51	- -
2	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
4	N. 2	.75	44	43.5	- -	S. W. 1	.75	45	47	*o*
6	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
8	N. 2	.73	43	37	- -	S W.	.80	51.5	37	*h*
10	- - -	- -	- -	- -	- -	- - -	- -	- -	- -	- -
12	N. 2	- -	- -	35	- -	S. W.	- -	- -	32	- -
	T. W. 37°.7.					T. W. 35°.8				

	August 25.					August 26.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	. . .	. .	. .	. .	. .	E.N.E. 3	29.[illegible]	[illegible]	[illegible]	b	Aug. [illegible]. At noon left Upernavik.
4	. . .	. .	. .	35	. .	E.N.E. 2	[illegible]	52.5	[illegible]	"	
6	. . .	. .	. .	. .	. .	E.N.E. 1	30.10	51	37	"	
8	calm	29°.87	52°	39	c	calm	.20	50	40	"	
10	. . .	. .	. .	. .	. .	E.N.E. 2	.12	54	37	"	
Noon	N. E. 2	.87	56	46.5	b	"	.10	53	36	"	
2	N. 2	.90	51	40	"	E.N.E. 1	.10	54.5	40	[illegible]	
4	E. by N. 4	.95	51	39	"	E.N.E. 2	29.97	54	41	[illegible]	
6	"	30.05	52	38	"	E.N.E. 3	30.00	52	38	"	
8	E.N.E. 3	29.90	50	35	"	"	.20	52	37	"	
10	"	30.00	51.5	34.5	"	E.N.E. 4	.10	51	37	"	
12	"	29.98	51	34.5	"	"	.05	47	[illegible]	[illegible]	
	T. W. 38°.6.					Lat. 71° 26′; long. [illegible] at noon. T. W. [illegible]					

	August 27.					August 28.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	E.N.E. 4	30.10	48	36	b	calm	30.02	55	36	b	Aug. 2[illegible]. At noon off Melon Land.
4	"	.00	54	36	"	var.	.05	55	38	"	
6	E.N.E. 2	.02	53	37.5	"	"	.02	54.5	41	"	
8	E.N.E. 1	.10	54	43	"	S.S.W. 1	.05	54	45	"	
10	"	.05	54	41	"	"	.00	53	45	"	
Noon	var.	.05	52	39	"	"	.00	51	46	"	
2	"	29.50	54	44	"	"	29.95	51	42	"	
4	"	.60	53	43	"	"	.95	52	50	f	
6	N. E. 1	.95	51	41	"	"	30.05	52	43	"	
8	N. E. 3	.70	52.5	39	"	"	.02	52	37	"	
10	calm	30.10	58	38	"	"	29.97	50.5	36.5	"	
12	"	29.80	60	37	"	"	.90	48	38	"	
	Lat. 69° 47′; long. 55° 11′. T. W. 39°.7.					At noon lat. 69° 35′; long. 54° 43′. T. W. 42°.0.					

	August 29.					August 30.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	S. W. 1	29.95	46	37	f	S. E.	29.90	58	45	b	Aug. 29, 4 A. M. Strong current setting in to the northward. 2 P. M., do.
4	"	.92	46	38	"	"	.50	56	39	"	
6	"	30.00	46	37	b	S. by W.	.75	53	41	"	
8	calm	.10	50	40	"	S. S. W. 2	.85	51	42.5	"	
10	"	29.95	52	47	"	"	.90	54	47	"	
Noon	"	.95	57	44	"	S. S. E. 5	.85	50	45.5	"	
2	S.	.90	55	50	"	"	30.00	50	42	c	
4	"	.85	57	54	"	"	29.90	51	45	"	
6	calm	.90	56	50	"	S. S. E. 4	.87	49	43	"	
8	"	.87	60	42	"	S. S. E. 2	.90	54	43	"	
10	W. 4	.90	64	40	"	"	.95	53	43	"	
12	S. E.	.95	60	40	"	"	30.10	51	43	"	
	T. W. 41°.2.					T. W. 40°.5.					

August 31.

Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	calm	29in.95	53°	43°	c
4	"	30.10	55	44	"
6	"	.00	53	41	"
8	...	--	--	--	"
10	...	--	--	--	"
Noon	W. 1	.10	53.5	41	"
2	...	--	--	--	--
4	...	.00	50	43	--
6	...	--	--	--	--
8	...	.20	50	38	--
10	...	--	--	--	--
12	...	--	--	40	--

T. W. 39°.9.

Aug. 31. At 9 A.M. came to anchor in Godhavn.

August 3, 0h A. M. Made fast to an iceberg; Hakluyt bears N. W. ½ N. (true). 2 A. M. South part of Herbert Island bears E. N. E. (true); distance ¼ mile: no bottom with 69 fathoms. 9 A. M. Cast off from berg and stood for Netlik. During the night experienced a very strong current setting from S. W. (true). 10½ P. M. Came to Netlik Harbor in 6 fathoms water. A rock in mid channel, dry at ¼ ebb, bears about S. W. from N. E. point of harbor.

Hour	September 1, 1861. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	September 2. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	...	--	--	--	--	...	--	--	--	--
4	...	--	--	40°	--	...	--	--	32°	--
6	...	--	--	--	--	...	--	--	--	--
8	...	30in.10	52°	38.5	r	N. E. 2	29in.90	55°.5	33	c s
10	...	--	--	--	--	...	--	--	--	--
Noon	...	.10	50.5	39	r	...	--	--	--	--
2	...	--	--	--	--	...	--	--	--	--
4	...	.15	--	39	r	...	--	--	--	--
6	...	--	--	--	--	...	--	--	--	--
8	...	.10	50	39	--	...	--	--	--	--
10	...	--	--	--	--	...	--	--	--	--
12	...	--	--	38	--	S. W.	--	--	--	--

T. W. 39°.7. | T. W. 37°.7

Sept. 1. At anchor.

Hour	September 3. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	September 4. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	...	--	--	--	--	...	--	--	--	--
4	S. W.	--	--	34	--	S. W.	--	--	34	s
6	...	--	--	--	--	...	--	--	--	--
8	S. W. 1	30.00	54	37	o	S. E. 1	29.90	49	--	--
10	...	--	--	--	--	...	--	--	--	--
Noon	S. W. 1	29.87	55	41	o	...	--	--	--	--
2	...	--	--	--	--	...	--	--	--	--
4	S. W.	--	--	39.5	--	S. E.	--	--	--	--
6	...	--	--	--	--	"	--	--	--	--
8	S. W.	.95	50	35	--	S. E.	--	--	--	--
10	...	--	--	--	--	...	--	--	--	--
12	S. W.	--	--	34.5	--	S. E.	--	--	--	--

T. W. 39°.3. | T. W. 38°.5.

Hour	September 5. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	September 6. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	...	..	..	..	..	...	..	..	..	..
4	S. E.	..	..	33	..	S	..	..	27	..
6	...	..	..	..	..	...	..	..	..	..
8	S. E	30in.14	48	37.5	..	...	..	..	..	..
10	...	..	..	..	..	...	..	..	..	..
Noon	S. 3	.22	49	39	..	S. W. 4	29.95	50.5	33	b
2	...	..	..	..	..	...	..	..	..	..
4	...	..	..	..	..	N. 1	.81	47.5	34.5	..
6	...	..	..	..	..	...	..	..	..	..
8	...	..	..	..	..	...	.79	47.5	31	..
10	...	..	..	..	..	...	..	..	..	..
12	S.	.14	38	37	..	...	..	..	28	..
	T. W. 37°.7.					T. W. 38°.0				

Hour	September 7. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	September 8. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	...	..	..	..	..	...	..	..	..	..
4	...	..	..	27	..	...	..	..	32	..
6	...	29.80	51	32	..	...	..	..	..	..
8	...	..	..	..	..	S. E. 4	29.72	50.5	37	b
10	...	.86	58	34	..	...	..	..	..	..
Noon	...	..	..	..	..	S. E. 4	.65	50.5	39	b
2	...	..	..	..	..	...	..	..	..	..
4	W. 1	.91	55	34.5	..	S. E. 4	.56	52	41	..
6	...	..	..	..	..	...	..	..	..	..
8	S. E. 2	..	..	34	c	S. E.	..	..	39	..
10	...	..	..	..	..	...	..	..	..	..
12	...	..	..	34	..	calm	..	..	38	..
	T. W. 37°.0.					T. W. 37°.3				

Hour	September 9. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	September 10. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	...	..	..	..	..	...	..	..	..	..
4	...	..	..	37	..	...	..	..	41	..
6	...	..	..	..	..	...	..	..	..	..
8	S. E. 3	29.52	52.5	41	c	S. W. 3	29.65	50	45	b
10	...	..	..	..	..	...	..	..	..	..
Noon	S. E. 4	.52	55	43	o q	...	.63	58	43.5	..
2	...	..	..	..	..	...	..	..	..	..
4	S. E. 1	.52	59.5	47	..	...	..	..	..	..
6	...	..	..	..	..	...	..	..	..	..
8	S. E.	..	..	42	..	S. E. 4	.77	59.5	..	..
10	...	..	..	..	..	...	..	..	..	..
12	S. E.	..	..	43	..	...	..	..	..	..
	T. W. 39°.4.					T. W. 39°.4.				

Hour	September 11.					September 12.				
	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	---	--	--	--	--	---	--	--	--	--
4	---	--	--	38°	--	---	--	--	39°	c
6	---	--	--	--	--	---	--	--	--	--
8	---	--	--	--	--	calm	29in.65	59°	37	r
10	---	--	--	--	--	---	--	--	--	--
Noon	N. 1	29in.85	50°	40	r	calm	.75	59	36	o
2	---	--	--	--	--	---	--	--	--	--
4	N. W. 1	.84	71	39.5	o	S. W. 1	.70	50	39	--
6	---	--	--	--	--	---	--	--	--	--
8	calm	.87	61	39	o	calm	--	--	36	--
10	---	--	--	--	--	---	--	--	--	--
12	S. E.	--	--	39	o	---	--	--	35	--
	T. W. 39°.4.					T. W. 39°.0.				

Hour	September 13.					September 14.				
	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	---	--	--	--	--	---	--	--	--	--
4	---	--	--	37	--	---	--	--	36	--
6	---	--	--	--	--	---	--	--	--	--
8	S. E. 2	29.75	54	37	--	calm	29.90	50	37	c
10	---	--	--	--	--	---	--	--	--	--
Noon	---	.72	58	39	o	S. 1	30.12	59.5	38	b
2	---	--	--	--	--	---	--	--	--	--
4	S. E. 1	.65	55	39.5	o	S. W. 1	-	--	40	--
6	---	--	--	--	--	---	--	--	--	--
8	N. by W.	--	--	36	--	---	--	--	--	--
10	---	--	--	--	--	---	--	--	--	--
12	S. W.	--	--	34.5	s q	---	--	--	29	--
	T W. 38°.3.					T. W. 38°.0.				

Hour	September 15.					September 16.				
	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	---	--	--	--	--	---	--	--	--	--
4	---	--	--	--	--	---	--	--	32	--
6	---	--	--	--	--	---	--	--	--	--
8	N. W. 1	29.65	50	40	--	calm	29.65	51	35	b
10	---	--	--	--	--	---	--	--	--	--
Noon	N. W. 1	.50	50	40.5	b	S. W. 1	.85	50	40	--
2	---	--	--	--	--	---	--	--	--	--
4	---	--	--	--	--	N. W. 1	.92	47	38	o
6	---	--	--	--	--	---	--	--	--	--
8	S. by E.	.47	58	35	--	calm	--	--	36	--
10	---	--	--	--	--	---	--	--	--	--
12	S. by E.	--	--	34	--	---	--	--	36	--
	T. W. 37°.5.					T. W. 36°.6.				

	September 17.					September 18.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	- - -	- -	- -	- -	- -	calm	29in.40	52°	37°	o	Sept. 17, 9½ A. M. Stood out of the harbor. At noon red beacon S. E. by S.; distance 4 miles.
4	- - -	- -	- -	34°	- -	S. E. 1	.45	56	39	"	
6	- - -	- -	- -	- -	- -	E.	.50	54	37	"	
8	S. E. 1	29in.72	48°	35	- -	"	.60	59	35.5	"	
10	- - -	- -	- -	- -	- -	"	.50	59	37	"	
Noon	N.N.W. 1	.90	47	39	- -	"	.50	47	37	"	
2	N. 1	.50	45	37	b	E.N.E. 4	.40	48	36	"	
4	N. 2	.60	50	36.2	"	"	.35	47	37	"	
6	"	.50	52	36	o	E.N.E. 7	.50	45	35	"	
8	N.N.W. 1	.65	56	36	"	"	.45	50	35	"	
10	N.	.50	55.5	40	"	N. E. 8	.40	53	35	"	
12	calm	.45	53	39	"	"	.45	52	36	s r	
	T. W. 37°.0.					At noon lat. 68° 15′; long. 54° 53′ T. W. 36°.8.					

	September 19.					September 20.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	N. E. 8	29.50	50	35	s r	N. E. 5	29.70	46	35	s	Sept. 20. Water thermometer No. 2 broke; No. 12 substituted.
4	"	.50	49	35	"	"	.75	45	35	"	
6	"	.45	47	34	"	"	.70	44.5	35	c	
8	"	.40	49	32	"	"	.60	45.5	34.5	"	
10	"	.50	49	35	"	"	.50	47	35	"	
Noon	"	.45	50	36.5	"	"	.60	47	40	c q	
2	N. E. 7	.70	48	36	"	E.N.E. 4	.75	49	37	"	
4	"	.70	49	36	"	"	.78	50	35.5	r	
6	E.N.E. 6	.65	50	35.5	o	"	.70	50 5	36.5	c	
8	"	.60	49	37	"	"	.80	57	35	"	
10	N. E. 5	.55	50	35	"	"	.60	53	36	"	
12	"	.70	50	33	c	E.N.E. 5	.68	50	36	"	
	At noon lat. 64° 50′ by D. R. long. 56 25 T. W. 36°.1.					At noon lat. 62° 39′ long. 56 20 W. var. 59°; T. W. 39°.2.					

	September 21.					September 22.					
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	
2	E. N. E.	29.60	50	36	c	N. N. E.	- -	- -	36	c	
4	E.N.E. 7	.55	50	37	"	"	- -	- -	36.5	c q	
6	E.N.E. 8	.60	50	37	"	"	29.70	51	36	"	
8	"	.60	50	37	r	N.	.60	55	36	"	
10	"	.75	50	37	"	- - -	.65	53	37	"	
Noon	"	.60	50	38	c	- - -	.70	50.5	37.5	h	
2	E.N.E. 7	.50	50	37	o q	N. 7	.60	50	37	c	
4	N. E.	.60	51	38	c	"	70	50	37	"	
6	N. N. E.	.50	50	37	"	N. W. 6	.60	57.5	37	"	
8	E. N. E.	.70	54	37.5	"	"	.70	55	37	"	
10	N. N. E.	.65	54	37	"	N. 5	.70	54	37	"	
12	"	.75	54.5	37	"	"	.80	50	87	"	
	At noon lat. 59° 23′ by D. R. long. 55 00 W. var. 56°; T. W. 40°.9.					At noon lat. 56° 28′ long. 52 56 W. var. 44°; T. W. 40°.7.					

	September 23.					September 24.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N.N.E. 4	29in.75	50°	38°	c	S. S. E. 5	30in.10	49°.5	43°	o
4	N N.E. 3	.72	53	37.5	"	"	.15	49	42	"
6	"	.80	52	37.5	"	"	.00	50	42	"
8	N.N.E. 2	.80	53	38	"	S. S. E. 7	29.90	50	37	"
10	"	.90	54	39	"	"	.82	50	43	"
Noon	N.N.E. 1	.90	54	43	"	S. S. E. 8	.88	54	46	o q
2	N. E. 1	.90	51	43	c	S. S. E. 3	.90	51	46	f r
4	E. by N. 2	.98	51	41	- -	"	- -	- -	- -	"
6	E. by N. 3	.95	51	40	- -	W. 3	.80	48	43	c
8	S. E. 3	30.00	52	40	o	N. W. 7	.60	50	41	"
10	"	29.92	51	41	"	N. W. 8	.58	50	39	"
12	"	30.00	50	43	"	"	.50	50	39	"

September 23: At noon lat. 54° 42′, long. 51 48. W. var. 46°; T. W. 43°.7.

September 24: At noon lat. 53° 27′ by D. R., long. 52 24. W. var. 38°; T. W. 42°.7.

Sept. 23. At 3 P.M. passed an iceberg about 5 miles distant. Rainbow seen.
Sept. 24. At midnight drifted past a small iceberg.

	September 25.					September 26.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N. W.	29.70	50	42	c	W.N.W. 7	29.60	48	42	o
4	"	.60	50	40	"	"	.70	48	43	"
6	W.N.W. 8	.60	47	39.5	"	"	.75	48	41	"
8	"	.70	47	40.	"	"	.80	51	42	"
10	"	.75	48	41	"	W.N.W. 6	.70	50	40	"
Noon	"	.80	49	40.5	"	"	.70	50	40	"
2	"	.70	47	40	o	N. W. 6	.80	48	40	c
4	"	.80	47	40	"	W.N.W. 6	.90	52	40	"
6	"	.68	48	40.5	"	"	.85	57	39.5	"
8	"	.70	49	40	"	"	.80	54	39	"
10	"	.60	48	44	"	"	30.00	55	41	"
12	"	.60	47	43	"	W.N.W. 5	29.90	56	41	"

September 25: At noon lat. 52° 57′ by D. R., long. 51 45. W. var. 36°; T. W. 43°.3.

September 26: At noon lat. 52° 26′ by D. R., long. 51 12. W. var. 33°; T. W. 43°.4.

	September 27.					September 28.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	W.N.W.	29.95	56	40	c	W. by N. 2	30.00	54	49	b
4	W.N.W. 3	30.05	54	42	"	"	.90	54	47	"
6	W.	29.90	54	43	"	"	.98	53	47	c
8	S. W.	30.00	53	43	"	"	.95	53	47	"
10	W. by S.	.02	51	46.5	"	W. by S. 2	.90	53	48.5	"
Noon	W.	29.96	52	47	"	"	30.05	53	49.5	b
2	W. 3	30.15	54	50	b	W.	.10	54	54	c
4	W. by S.	.10	52	51	"	"	29.95	56	51	- -
6	W. 2	.10	54	50	"	W.S.W. 2	30.02	54	52	c
8	"	29.98	54	50	"	var.	.10	54	50	- -
10	"	.95	55	47	c	W. by S.	.20	58	50	b c
12	"	.90	54	46	r	"	.20	58	48	- -

September 27: At noon lat. 49° 5′; long. 48° 55′. W. var. 33°; T. W. 47°.3.

September 28: At noon lat. 47° 42′; long. 48° 5′. W. var 33°; T. W. 46°.4.

	September 29.					September 30.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	W.S.W. 2	29in.95	57°	50°	*f*	N.W.by W.	30in.05	61°.5	54°	*c*
4	"	.98	58	50	"	N. N. W.	.10	59	51	- -
6	W. by S.	30.05	58	51.5	- -	"	.00	50	53	*f*
8	W. by S. 2	.95	56	53	*f*	"	.00	54	54	*c*
10	W.S.W.	30.00	58	54	"	N.N.W. 3	.00	53	50	*b*
Noon	"	.10	57	55	"	"	.05	52	48.5	"
2	W. 3	29.90	59.5	56	"	N.N.W. 2	.15	52	48.5	*c*
4	W. by S. 3	30.00	58	56	"	"	.20	54.5	50	"
6	S.W.by W.	.10	59	56	*r*	N.W.by W.	.00	55	50	"
8	"	.20	62	56	"	N. W. 2	29.95	55	51	"
10	W.S.W. 2	.15	61.5	55	"	N.W.by W.	30.05	56	50	- -
12	W. by S. 2	.10	52	55	*o*	N. W. 2	.10	55.5	50	- -

September 29: At noon lat. 47° 19′ by D. R.
long. 49 27
W. var. 30°; T. W. 50°.7.

September 30: At noon obs'd lat. 46° 54′
" long. 50 39
W. var. 27°; T. W. 51°.6.

	October 1, 1861.					October 2.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N.W.by N.	30.00	55	50	*b c*	N.W.by W.4	30.24	55	51	*c*
4	"	.00	54	50	"	"	.10	55	51	"
6	N.N.W. 4	29.90	53	47	*c*	"	.05	56	53	"
8	N.N.W. 3	30.10	53	48	*b*	N.W.	.10	57	53	"
10	N.	.15	52	49	"	N. W. 3	.00	54	53	"
Noon	"	.20	53	49	*c*	"	.00	55	53	"
2	N. N. W.	.00	54	48	"	W.N.W. 4	.08	59	57	"
4	- - -	.00	52	48	"	N.W.by W.6	.20	59	56	- -
6	var.	.23	52	48	"	N. N. W.	.05	58	55	- -
8	N. W.	29.95	55	49	"	N.W.by N.	.10	58	56	*c*
10	N. N. W.	30.10	55	52	*q r*	N. 2	.16	60	55	"
12	"	.10	55	52	- -	"	.20	60	55	"

October 1: At noon lat. 45° 21′ by obs'n
long. 52 36
W. var. 25°; T. W. 55°.1.

October 2: At noon lat. 44° 2′ by obs'n
long. 53 55
W. var. 27°; T. W. 58°.9

Oct. 1. At noon cast of lead gave 43 fathoms, gravel and gray sand.

Oct. 2, 8 A. M. Spoke brig "Liverpool," 2½ P.M. spoke Eng. ship "Robert Parker."

	October 3.					October 4.				
Hour	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N.	30.25	60	55	- -	S. W.	29.90	68	63	*r q l*
4	N. 1	.20	60	54	- -	W. by N.	.80	67	63	"
6	calm	.10	61	53	*o*	W. by N. 3	30.00	65	61	*b*
8	S. S. E.	.00	60	54	*c*	W.N.W. 2	.05	64	59	"
10	S. W. 2	29.90	59	59	"	"	.10	62	56	- -
Noon	S. W. 4	.88	62	62	*o*	"	.05	62	59	- -
2	S.W.by S.4	.85	64	62	*r q*	N. W.	29.90	61	63	*o*
4	S. W. 3	.95	67	63	*b c*	"	.90	61	63	"
6	W.S.W.	.90	67	64	*o*	N.N.W. 4	.82	60	55	"
8	W.S.W. 4	.95	70	64	*c*	N.W.by W.	.95	60.5	55	*r*
10	W.S.W. 2	30.05	70	64	*b*	N. by W.	.80	57	52	"
12	"	29.98	69	63	"	"	.80	57	52	- -

October 3: At noon lat. 43° 35′ by D. R.
long. 55 02
W. var. 26°; T. W. 62°.7.

October 4: At noon lat. 44° 18′ by obs'n
long. 55 00
W. var. 26°; T. W. 59°.8.

Hour	October 5. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	October 6. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	N. 3	29in.73	56°	53°	c	N. E. 1	30in.25	57°.5	51°	c
4	"	.80	55	52	"	S. E. 1	.30	58	52	"
6	N. by W.	.85	54	52	- -	"	.30	58	53	"
8	"	.80	55	51	c	E. S. E.	.30	59	54	r
10	"	.80	54	52	o	S. 4	.20	59	59	c
Noon	"	.80	54	51	"	"	.28	63	61	"
2	N. by W. 4	30.10	54	52.5	c	S. by W. 4	.25	68	62.5	"
4	"	.15	55	51	"	S. S. W.	.30	67	64.5	"
6	"	.20	55	50	- -	"	.20	67	64	o
8	"	.10	56	49	- -	S. W. 4	.40	66	65	"
10	N.N.E. 3	.30	56	51	c	"	.10	65.5	64	b
12	N. E. 2	.35	57	51	"	"	.20	62	63.5	"

October 5. At noon lat. 43° 27′ by obs'n long. 56 51
W. var. 23°; T. W. 58°.8.

October 6. At noon lat. 43° 05′ by D. R. long. 59 28
W. var. 22°; T. W. 63°.4.

Oct. 6, 5½ P. M. Kept away for Halifax, being unable to carry head sail, having no spars on board to repair damages.

Hour	October 7. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.	October 8. Wind D. and F.	Bar.	Att. ther.	Temp. air.	Weather.
2	- - -	30.30	65	61	b	calm	30.24	63	61	f
4	S.W. by S.5	.20	62	58	"	"	.05	64	60	o
6	"	.30	64	62	"	E.	.10	65	60	"
8	"	.25	65	63	"	W. by S.	.15	64	58	f
10	"	.20	67	64	"	E.	.10	63	58	"
Noon	W.S.W. 5	.30	66	65	o	E. 2	.00	63	58	"
2	S. W.	.20	66	63	f	E. S. E. 2	.10	62	58.5	"
4	"	.20	65	62	"	"	.06	61	57	"
6	W. by S. 2	.20	65	61	"	S. by E.	.10	62	59	"
8	W.S.W. 1	.15	63	60	"	S. S. W. 3	.10	63	60	"
10	"	.20	62	60	"	"	.08	65	60	"
12	"	.20	65	60	b	"	29.82	65	60	r

October 7. At noon lat. 43° 45′ by D. R. long. 63 20
W. var. 22°; T. W. 59°.5.

October 8. At noon lat. 44° 05′ by D. R. long. 64 31
W. var. 1½ pts.; T. W. 57°.9.

Oct. 7, ½ P.M. Spoke bark "Regina." 4 P. M. No bottom with 65 fathoms. 8 P. M. No bottom with 65 fathoms. 10 P.M. by alt. of Polaris lat. 44° 4′. Cast lead; no bottom; 65 fathoms.

Oct. 8, 2 A.M. No bottom with 60 fathoms. 11 A.M. in 42 fathoms water, coral, gravel, & shell. 0h 25m P. M. Dense fog; made the land bearing N.W. by W. ¼ of a mile distant.

Hour	October 9. Wind D. and E.	Bar.	Att. ther.	Temp. air.	Weather.
2	N.N.W. 3	29.85	61.5	61	r
4	N.	.90	60	60	"
6	"	30.00	60	56	"
8	N. E. 3	29.90	60	52	c
10	"	.85	61	53	"
Noon	"	30.20	57	52.5	"

T. W. 56°.7.

Oct. 9, 6 A.M. Took pilot on board; entered Halifax Harbor; at anchor until Oct. 19.

1861. October 19. 1 P. M. Stood out of the harbor.
20. At noon lat. 43° 14′ by obs'n; long. 61° 32′
21. " " 41 58 " " 66 22
22. " " 42 17 " " 69 27

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